AGRICULTURAL RESEARCH INSTITUTE
PUSA

PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY

OF LONDON.

1917, pp. 1-215,

WITH 6 PLATES and 82 TEXT-FIGURES.

PRINTED FOR THE SOCIETY,
SOLD AT ITS HOUSE IN REGENT'S PARK.
LONDON:
MESSRS. LONGMANS, GREEN, AND CO.,
PATERNOSTER ROW.

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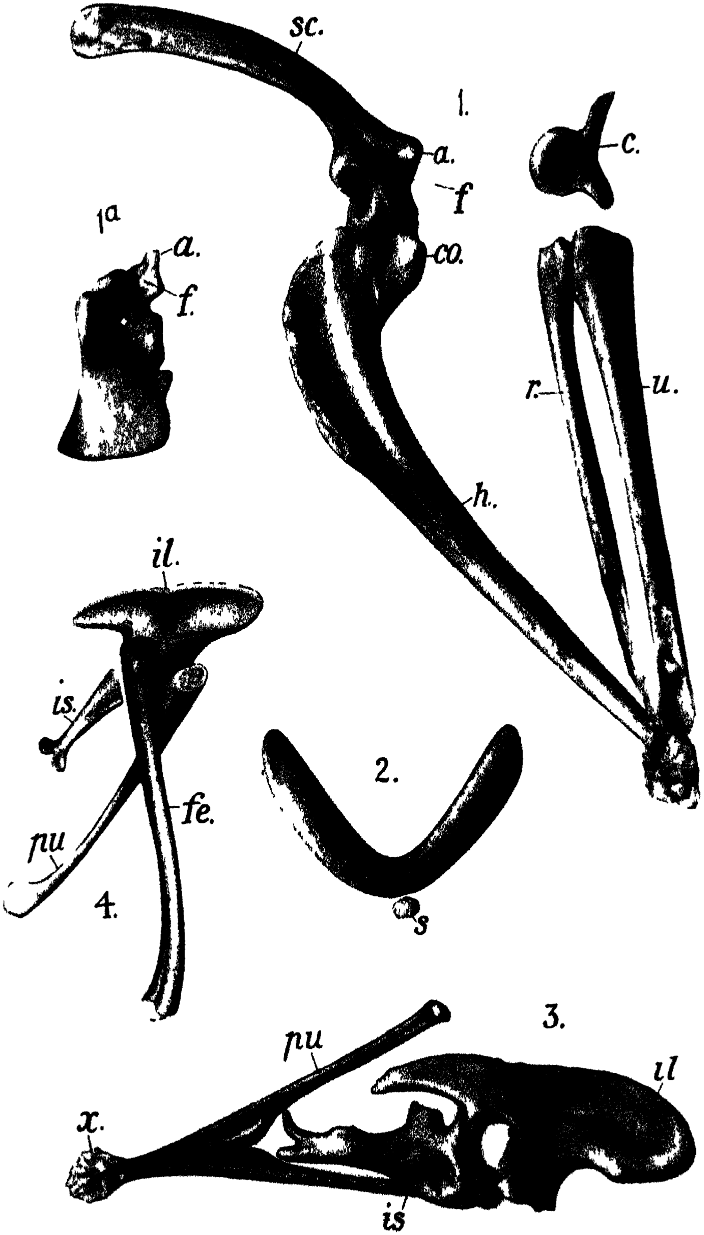

ARCHÆOPTERYX.

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[Received and Read November 21, 1916.]

(Plate I.*)

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Introductory.

Some further preparation of the British Museum specimen of *Archæopteryx* recently done by Mr. F. O. Barlow, under the direction of myself and Dr. Woodward, has resulted in the complete uncovering of the right coracoid bone and the discovery of the pubes. The work was undertaken at my request after I had convinced myself, by a prolonged study of this specimen in connection with Dames' two memoirs on the Berlin *Archæopteryx*, that the bones in question must exist buried in the limestone matrix. On the results I have prepared an exhaustive paper, which I hope to publish later; but the following preliminary notice, written by Dr. Woodward, who has made use of our joint observations, gives a general account of the important additions to our knowledge of the pectoral and pelvic arches of this primitive Jurassic bird which are now made possible. Some differences of opinion between us are indicated in footnotes.

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* For explanation of the Plate see p. 6.

I have to thank Dr. Woodward and also Dr. C. W. Andrews for the valuable help and advice they have given to me.—B. P.

Pectoral Arch.

The right scapula and coracoid are completely exposed on their outer face (Pl. I. figs. 1, 1 *a*) and apparently almost uninjured. They meet in a very wide angle and are fused together, though their limits are marked by a line across the glenoid cavity and a notch at its outer edge.

The scapula (*sc.*), which has already been described by Owen (1863) and Dames (1884), is typically avian and about twice as long as the coracoid. Its distal end is slightly expanded, as in *Casuarius*; while its proximal end bears a well-developed acromial process (*a.*), from which a very thin lamina of bone, with roughened surface, extends to the coracoid, forming the floor of a hollow (*f.*) in which the furcula evidently articulated.

The coracoid (*co.*) is a quadrilateral plate of bone longer than wide, and not much narrowed at the upper or humeral end, where it is somewhat thickened. The bone is bent at an obtuse angle along a line extending obliquely from the outer end of the humeral border to the inner end of the sternal border, so that the infero-external half must have been almost in the same plane as the expansion of the sternum, while the supero-internal half faces inwards. The wide upper portion of this internal half is pierced near the middle by the usual coracoid foramen. The thickened upper or humeral border bears two eminences, a larger adjacent to the margin of the glenoid cavity and a smaller at the outer angle of the bone, where it extends a little down the outer border (fig. 1 *a*). Below this eminence the outer border is thin and slightly excavated, meeting the equally thin but straight lower (or sternal) border in an obtuse angle. The inner border, which meets the lower border in a right angle, appears to be still thinner and forms a somewhat jagged edge in which two indents are probably natural*. The upper and larger of these, which is semicircular, occurs at the upper end; the smaller indent further down is bounded below by a slight prominence†. The irregularities in the rest of the border are probably due to imperfections in the fossil.

---

* I consider that the upper indent is certainly natural.—B. P.

† I think I can distinguish a faint line extending from the hollow between the upper eminences to the middle of the lower indent of the inner border. This may perhaps mark the division between the precoracoid and the true coracoid—in which case the glenoid eminence would be on the former, the second eminence on the latter. The eminence on the coracoid would thus be homologous with the spina coracoidea of the Ratites and the acrocoracoid of the Carinates, while the intervening hollow would correspond with the fossa supracoracoidea of the Ratites (*cf.* M. Fürbringer, 'Untersuchungen zur Morphologie und Systematik der Vögel,' vol. i. (1888) pp. 36, 39, 40).—B. P.

As remarked by Huxley (1868), the furcula (Pl. I fig. 2) is exposed from its ventral face. The new preparation of the specimen has only defined more clearly the shape of the upper articular end on the left side*.

TABLE OF MEASUREMENTS.

	mm.
SCAPULA :	
Greatest length to apex of acromion	46
Greatest breadth of distal end	6
" " proximal end	11
Smallest breadth	3
Greatest diameter of scapular part of glenoid fossa	5
CORACOID	
Greatest length from prominence above glenoid fossa to infero-internal angle	19
Breadth at upper (humeral) border	9
Breadth at middle	12
Breadth at lower (sternal) border	12
Greatest diameter of coracoidal part of glenoid fossa	3
FURCULA	
Greatest length	21
Greatest width	31.5
Greatest breadth of bone	4
Inner angle of furcula about 90°.	

It would be interesting to compare the pectoral arch of *Archæopteryx*, as now made known, with the corresponding parts in the second specimen in Berlin; but, unfortunately, according to the description by Dames (1897), the several bones in the latter fossil are so imperfect, crushed, and obscured that no satisfactory comparison is possible†. It must suffice to note that, although *Archæopteryx* was obviously a bird of flight, its scapulo-coracoid is more closely similar to that of certain Mesozoic reptiles than that of any other known bird, and the nearest approach in shape to its coracoid is found in the existing Ratites and the Cretaceous *Hesperornis*. In the fusion of the scapula with the coracoid and the very wide angle at which these bones meet, it agrees only with the ratite birds and the reptiles.

Pelvic Arch.

In the pelvic arch (Pl. I. fig. 3) the right ilium (*il.*) and ischium (*is.*) are exposed on their outer face, while the two pubes (*pu.*) are displaced and seen from above. The bones were evidently all separate, and the ilium must have been only loosely articulated with the sacrum, which is proved to be absent by an exploratory excavation made in the stone beneath the pelvis.

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* A small prominence on the stone below the middle of the furcula may perhaps mark the anterior end of the sternum (Pl. I. fig. 2, *s*).—B. P.

† I venture, however, to make the comparison, notwithstanding imperfections in the Berlin specimen.—*B. P.*

The relatively large preacetabular portion of the ilium (*il.*) is elliptically rounded in front, and the hinder half of its lower border is gently excavated where it forms the sharp outer edge of the concave anterior face of the large deep pedicle for the articulation of the pubis. The middle of the outer face of the bone is deeply concave, while its lower margin is convex. The acetabulum is deeper than wide and, though perforate, is partly closed by a thin marginal lamina of bone, which is preserved at its anterior border. Above the acetabulum the ilium is slightly convex, but bears no trace of an anti-trochanter. The post-acetabular portion of the bone is a relatively small narrow extension, slightly arched and tapering to its hinder end, which is imperfect in the fossil. Its outer face is gently concave. The posterior pedicle is also small, and obliquely truncated for the articulation of the ischium.

The ischium (*is.*) appears to be in its natural position, but is distinctly separated by suture from the ilium. It is expanded proximally, though slender behind, and bends inwards at its distal end, where it bifurcates into two sharply separated processes. The upper of these processes is the longer and curves upwards; the lower and shorter process is nearly straight. The anterior border of the proximal expansion is slightly excavated to form about half of the posterior rim of the acetabulum. Above and below this there is a short articular surface for the ilium and the pubis respectively. Shortly behind the former articulation the upper border rises into a quadrangular process; and there is a second but less elevated process of nearly the same shape further back. The anterior portion of the lower border is strongly convex. The outer face of the proximal expansion of the bone is marked by an ovoid depression, at the bottom of which there is a foramen.

The pubes (*pu.*) are long, slender, and nearly straight bones projecting backwards far beyond the ischia, where they meet without fusion in an extended symphysis. The proximal articular end, best preserved on the right side, is convex and ovoid, its long diameter being transverse. The slender shaft of the bone curves slightly upwards to this articular end, and in the bend there is a large foramen, well seen on the left side. The lower face being obscured, it is impossible to determine whether or no a pectineal process is present. As the bone approaches the hinder symphysis, it gradually widens in a horizontal plane at its inner edge until its maximum width is reached at the beginning of the symphysis. The apposed pair of nearly horizontal laminæ taper gradually backwards until they end in a slightly upturned point and are lost in an irregular mass of calcite (*x.*) which probably represents original cartilage.

TABLE OF MEASUREMENTS.

	mm.
ILIUM:	
Greatest length (as preserved)	39
Length from middle of anterior acetabular border to anterior end	23
Same measure to posterior end (as preserved)	16
Width of acetabulum	6
Greatest depth (at articulation for pubis)	15
ISCHIUM:	
Greatest length	27
Greatest breadth (at proximal end)	10
Least breadth (near middle)	3
PUBIS:	
Greatest length	47
Length of median symphysis of hinder expansion	19
Least breadth (near proximal end)	2
Greatest breadth of hinder expansion	4

The pelvis of *Archæopteryx*, as now described, can be more satisfactorily compared with that of the second specimen in Berlin than the pectoral arch to which reference has already been made. In the pelvic region, however, the Berlin specimen is somewhat differently crushed, all three elements being exposed in direct side view, with the femur in its natural position overlying them and obscuring the proximal end of the ischium. The figure published by Dames, 1897 (copied in Pl. I. fig. 4), is, indeed, rather diagrammatic, and suggests imperfections in the state of preservation of parts of the bones, which must be taken into account. Small differences in shape between the ilium and ischium of the two specimens have already been noted both by Seeley (1881) and by Dames (1897), who include them among the marks of at least specific distinction which they recognise in the two skeletons. Still more striking differences now appear, at first sight, between the pubes; but it must be remembered that in the British Museum specimen these bones are seen from above, while in the Berlin specimen the right pubis alone is exposed in outer side-view. Making allowance for the imperfection of the proximal ends in the latter case, the relative length of the ischium and pubis is approximately the same in the two fossils, and the terminal expansion in the Berlin specimen may well be the apparently cartilaginous mass (*x*.) of the British Museum specimen crushed from side to side. Essential differences, therefore, are not yet demonstrated *.

Among existing birds, the pubes meet in a symphysis only in one genus, the Ratite *Struthio*; and here there is no resemblance in shape to the corresponding symphysis in *Archæopteryx*. The nearest approach to the form of the pubis in the fossil appears to occur in *Colymbus*, where the incurved distal end of the long slender bone expands inwardly into a delicate triangular lamina, but does not meet its fellow of the opposite side.

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* I am of opinion that future discoveries will result in demonstrating such differences. I do not think that a side-view of the pubes in the British Museum specimen would correspond with that shown in the Berlin specimen. I consider that the cartilaginous end of the British Museum specimen is not homologous with the bony expansion of the Berlin specimen; and I conclude that there cannot have been any pubic symphysis in the latter. I therefore refer the so-called *Archæopteryx siemensi* to a distinct genus *Archæornis*, which will be defined by differences in the pectoral arch as well as in the pelvis.—B. P.

While distinctly avian, therefore, the pelvis of *Archæopteryx*, like the pectoral arch, is more closely similar to that of certain reptiles than that of any other known bird; and the only existing bird repeating its most characteristic feature, the symphysial union of the pubes, is a ratite.

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EXPLANATION OF THE PLATE.

Fig. 1. *Archæopteryx macrura* Owen, fore limb as displayed on the slab of stone, about four-thirds nat. size. Lithographic Stone (Lower Kimmeridgian), Solenhofen, Bavaria. [British Museum no. 37001.]

1 *a*. Coracoid of same in front view.

2. Furcula of same specimen, ventral face, about four-thirds nat. size.

3. Pelvis of same specimen as displayed on the slab of stone, about four-thirds nat. size.

4. *Archæopteryx siemensi* Dames; pelvis, right side view, about nat. size. Ibid. [Berlin Museum of Natural History.] After Dames, 1897.

a., acromial process of scapula; *c.*, carpus (with distal extension probably of calcified tendon); *co.*, coracoid; *f.*, facette for furcula; *fe.*, femur, *h.*, humerus, *il.*, ilium; *is.*, ischium, *pu.*, pubis; *r.*, radius; *s.*, supposed anterior end of sternum, *sc.*, scapula, *u.*, ulna; *x.*, calcite probably representing imperfectly calcified cartilage.

2. On Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai. By ARTHUR DE CARLE SOWERBY, F.Z.S.

(Received October 9, 1916: Read February 20, 1917.

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For many years the numerous species of mammals described or named by Père Heude in his 'Memoires concernant l'Histoire Naturelle de l'Empire Chinois' have been a stumbling-block in the path of naturalists who have tried to arrive at a proper understanding of the mammalogy of China and adjacent countries.

Père Heude in the eighties and nineties of the last century, with the help of numerous Catholic missionaries in the field, gathered together a fine collection of mammals, birds, reptiles, and other forms of animal life in the Sikawei Museum at Shanghai. With his peculiar ideas on what constitutes specific characters in animals, he set about classifying and naming such mammals as came into his hands, with the result that he enormously multiplied the number of species in China, especially in the genera *Sus*, *Cervus*, *Capricornis*, and *Nemorhædus*, thereby reducing the subject to a state bordering on chaos; subsequent workers finding themselves confronted with such bewildering facts as eight species of pigs and eleven species of sika (six from one locality and seven from another) scattered over China, not to mention some seventeen species of goral and seven or eight bears. That such could not really be the case was obvious, but without good series of specimens from Heude's type-localities, or at least his own specimens for examination, the matter could not be cleared up.

During the past few years collectors and sportsmen have secured a few specimens of the larger mammals such as pigs, serows, gorals, and bears, but the material has been altogether insufficient to be of much help.

I believe attempts have been made to get hold of Heude's collection, either by purchase or exchange, for some of the more important museums of Europe and America, but without success.

There remained therefore only two things to be done—either the securing of series of specimens from all of Heude's collecting-grounds, or the revision, on the part of someone fitted for the task, of his collection in the Sikawei Museum.

In 1914 Mr. Gerrit S. Miller, jun., of the Division of Mammals, Smithsonian Institution, suggested to me that I should attempt both of these tasks. I agreed to try, but so far have found the collecting of the mammals in question from the same or near-by places as those whence Heude's specimens were secured an almost hopeless task.

In the first place, many of the species have become very rare in the past few years. Then, too, the conditions under which one has to work can never yield the same results as were obtained by Heude's collectors. A protracted residence in each type-locality would be necessary, while one would have to enlist the services of local native hunters with a knowledge of the country and quarry to secure the required specimens. For instance, the difficulty of securing specimens of the serow may be gathered from the account of Fenwick Owen's recent trip through Central China.

Four successive trips into Manchuria on my part have yielded only one specimen of pig, four bears, three wapiti (or red deer), one roe, and two gorals. No sika were secured, though specimens in captivity were seen. These trips have taken a considerable amount of time and money, and the poor results, so far as the larger mammals are concerned, have been disappointing in the extreme; but, with the great increase of settlers, the cutting away of the big forests, and the unceasing hunting on the part of natives, to which the animals are subject, one could expect nothing else.

On the Yang-tze, where, in Heude's time, the sika seems to have been so plentiful, that beautiful deer is now very rare, while wild pigs are noticeably fewer than they were, large specimens being particularly difficult to secure.

A trip made by me last spring (1915) into the high mountainous region of South Shensi after big game yielded only a couple of takins. Serows and gorals, although said to be plentiful by the natives, were not even seen. Several hunting and collecting expeditions into Central and West China in the past few years have yielded little better results. Fenwick Owen, already mentioned, got one serow, but neither goral nor wild pig. J. W. Brooke got a goral and a couple of serows, which the late Mr. Lydekker mentioned in a paper read before the Zoological Society of London in 1908.

Mr. Malcolm P. Anderson's last expedition yielded no specimens of the serow, though he went right through the country inhabited by those animals. He secured a goral and a wild pig in the Tai-pei-shan region of South Shensi.

On the Clark expedition in 1909 I secured a goral in the mountains south of Si-an-fu and a fine adult boar in North-Central Shensi, near Yen-an-fu. I have also secured gorals and wild pigs in North and West Shansi, but the mammals of this province, with the exception of the sika, seem to have escaped Heude's attention, so that my specimens can have little or no bearing upon the subject.

Since, then, the collecting of series of specimens from Heude's type-localities was going to prove a long if not a hopeless task, there remained only the alternative of going over his material in the Sikawei Museum. Through the courtesy of the Jesuit Missionaries in charge I was able to do this, and the following is an attempt to arrive at some definite conclusion as to the validity or otherwise of Heude's numerous species, and to determine therefrom the number of distinct species contained in the genera *Sus*, *Cervus*, *Capricornis*, and *Nemorhædus* in China, Corea, Manchuria, and the adjacent portions of Thibet.

Without intending to cast any slur upon the present curator of the Museum, I must state that I found the specimens in some confusion, due to the fact that Heude died in the midst of his labours, leaving no one to fill his place or carry on his work. The specimens were not numbered; some of them even lacked labels, so that it was with great difficulty that I found many of the specimens of the species described and figured in the publication already referred to in the beginning of this paper.

Owing to the inevitable ravages of time and insects in such a climate as that of Shanghai, I found the condition of the skins very poor, and so was forced to confine my observations almost entirely to the skulls of the specimens, but where possible I went over the skins as well and drew conclusions from them. In regard to the pelts I found that Heude had evidently regarded seasonal differences in colouring as specific, just as with the skulls it was obvious that he had made specific differences out of those due to age and sex. How so able a naturalist came to make these errors it is difficult to understand; and I want to make it clear that in spite of his peculiar views on the classification of species, Heude must be considered as one of the fathers of Chinese mammalogy just as Père David was the father of Chinese ornithology.

As regards the names of the species upon the labels attached to the specimens, it was no uncommon thing to find that the original name had been erased and substituted by another, which, in some cases, was again erased and replaced by a third and fourth. Sometimes one name would appear on the label, while another would be written on the skull itself, and only in a very few cases was the word *type* to be found.

However, after going over the specimens carefully, I am satisfied that I found most of the skulls figured by Heude.

Another point to be noticed is that many of the specimens are labelled from certain localities, while, in the descriptions of the species, other, and in some cases somewhat misleading, localities are assigned. Thus, of the sikas from the Poyang Lake District, seven species are labelled by the original collector "*Kienté*." In Heude's descriptions of these species, he gives the localities variously as "hills of Kienté," "territory included between the north-east of the Poyang Lake and the Blue River," "Central China," "Poyang Lake," etc. As a particular instance, take the specimen marked *Sika lachrymosus*. In the collection it is labelled *Kienté* by the collector, yet Heude's description of it gives its locality as *Central China*, which, to say the least of it, is misleading.

Before going into details about the specimens themselves, it would be well to get an accurate idea of just where Heude's collections were made, and, in making out the following list, I have relied more upon the localities on the labels of the actual speimens than upon those given in the descriptions. I have been at some pains to get the list as accurate as possible.

1	Ning-kuo-fu	S. by S.E. of Nanking, Anhui Province. Pig and sika were collected here.
2	Kienté	(Chienté) N.E. of Poyang Lake, S. of Anking-fu, Anhui Province. Pig and sika were collected here.
3.	Tonglieou	(Táng-liu) a little to the N. of Kienté on the bank of the Yang-tze, Anhui Province. Sika collected here.
4.	Tchen-kiang	(Chinkiang) on the Yang-tze, below Nanking, Kiangsu Province. (The specimen of *Sus paludosus* described as from the Kiangyin River at Nanking was secured by Carnie and is marked on the label as from Tchen-kiang.) Pig collected here.
5.	Tchang-cheou .	(Cháng-chou) on the Yang-tze between Chinkiang and Shanghai, Kiangsu Province. Pig collected here.
6.	Chao-hing-fu . .	(Hsao-shing-fu) S.E. of Hangchow and W. of Ningpo, Chekiang Province. Serow secured here.
7.	Ki-hsien .	(Chi-hsien) probably near Hsao-shing-fu, Chekiang Province. Goral secured here.
8.	Kuangsi	Province of Kuangsi, South China. The specimen *Sus meles* is labelled Kuangsi, with no further particulars as to exact locality.
9.	Kouang-tung ..	(Kuang-tung or Canton) Nan-iong or Nanyang, where the specimen of *Capricornis collasinus* was secured, lies in the extreme north-eastern corner of the Province of Kuang-tung.
10.	Yi-chang . .	(I-chang) a well-known Treaty Port on the Yang-tze, above Hankow, in the Province of Hupei. Goral secured here.
11.	Kiun-tcheou .. .	(Chuin-chou) probably in the vicinity of Yun-yang-fu, N.W. Hupei. (The specimen of *Nemorhædus fantozatianus* was labelled N.W. Hupei.)
12.	Tchen-kou-ting . .	(Chén-k'ou-ting) in the extreme N.E. of Ssuchuan, close to the Shensi-Hupei border. A large number of serow and goral came from this spot collected by Paul Farges.
13.	The Upper Han Valley.	Near Han-chung-fu, S.W. Shensi. Pig and serow collected here.
14.	Mountains south of Si-an-fu, Shensi.	Goral collected here.
15.	Paoki	(Pao-chi) W. of Si-an-fu, S.W. Shensi (not north, as stated in Heude's description) near the Tai-pei-shan region. Bear collected here.
16.	West Ssuchuan ..	(No more specific locality on label.) Serow and goral collected here.
17.	Moupin	North-west Ssuchuan and adjacent portion of Thibet. Goral, serow, and bear collected here.
18.	Kechen, Keso, and Along Bay, Tongkin.	Serow collected here.

19. Tsing-lo Hsien	W. Shansi, near Ning-wu-fu. Sika horns from here.
20. Mukden	Manchuria. Pig and sika collected here.
21. Sungari	Valley of the Sungari River, Manchuria. Pig and sika collected here.
22. Vladivostok	Primorski, on the Maritime Province near S.E. Manchurian border. Pig and sika collected here.
23 Oussouri	(Ussuri) Ussuri Valley, between Kirin Province, Manchuria, and Primorski, Siberia. Bear, pig, and goral collected here.
24. Fusan and Ousi	Corea (Eastern Coast). Pig collected here.
25. Central Japan	Pig from here.
26. Hakodate	(Yeso) North Japan Island. Bear from here.
27. Marche	From which place there is a skull of a pig with the name *Sus angusticeps* inscribed on the label I cannot discover it on the map, but from the specimen I should judge it to be in the Yang-tze region. Heude also has described two sika from Shantung, but I failed to find the specimens in the Museum.

Genus Sus.

Altogether I examined the skulls of thirty (30) pigs from thirteen (13) localities, amongst which there were no less than eighteen (18) species according to Heude's classification. After careful comparison, however, I could not find grounds for distinguishing more than five (5) distinct species. The following list, which gives details of the skulls examined, incidentally comprises practically the entire collection of wild pigs' skulls from China, Manchuria, and Japan in the Museum:

1 3 skulls ♂ ♂ of *Sus collinus* from Kienté.
2. 4 skulls ♂ ♂ of *Sus chirodontus* from Kienté.
3. 2 skulls ♂ ♂ of *Sus stricticeps* from Kienté.
4. 1 skull ♂ of *Sus acrocranius* from Kienté
5. 3 skulls 2♂ ♂, 1♂ of *Sus flavescens* from Ning-kuo-fu and Li-yang.
6. 2 skulls ♂ ♂ of *Sus paludosus* from Tchen-kiang (Chinkiang).
7. 2 skulls 1♂, 1♀ of *Sus nigricans* from Tchang-cheou.
8. 1 skull ♂ of *Sus laticeps* from Shensi.
9 1 skull ♂ of *Sus curtidens* from Shensi.
10. 1 skull ♂ of *Sus oxyodontus* from Shensi.
11. 1 skull ♀ of *Sus moupinensis* Milne-Edwards, from Shensi.
12. 1 skull ♂ of *Sus meles* from Kuangsi.
13. 2 skulls ♂ ♂ of *Sus gigas* from Vladivostok.
14. 1 skull ♀ (juv.) of *Sus songaricus* from Sungari Valley.
15. 1 skull ♂ of *Sus ussuricus* from Ussuri Valley.
16. 2 skulls ♂ ♂ of *Sus coreanus* from Fusan and Ousi, Corea.
17. 1 skull ♂ of *Sus angusticeps* from Marche.
18. 1 skull ♂ of *Sus nipponicus* from Japan Central.

In this list it will be noticed that I have given the localities marked on the labels, which, as already mentioned, do not always seem to agree with the locality given in the description of the species.

1. SUS PALUDOSUS Heude.

In comparing the skulls of the first seven species in the above list (*i. e.* the species inhabiting the Yang-tze Valley) one was struck by the fact that they were practically indistinguishable one from the other, except that some were larger than others, slightly heavier, and with more worn teeth.

I have no hesitation in saying that the differences occurring amongst the skulls of this series were due either to individual variation or age. Thus, the skull labelled *S. paludosus* from Chinkiang, being the oldest specimen, as evidenced by the wearing of the teeth, was very heavy throughout and proportionately broader than any of the others. The type-specimen of *S. chirodontus* was longer in proportion to its width than any of the others, but not sufficiently so to warrant its separation from them as a distinct species, for in this respect it also differed from the other specimens labelled *chirodontus*. One of the specimens labelled *S. chirodontus* from Kienté has *S. stricticeps* written in ink on the palate, and was (judging from erasures on the label and marks on the skull) also originally the type of *S. collinus*. *S. acrocranius* was originally labelled *S. chirodontus*. One of the specimens of *S. flavescens* from Li-yang was very high in the forehead, giving a strongly concave outline to the cranium. It was originally labelled *S. leucorhinus*, but the describer evidently changed his mind about it. This all goes to show that Heude himself had considerable doubt about the specific differences of his species.

Taking the whole of the series from the Yang-tze Valley, I should not hesitate to class them as one species, with the note that the specimens from Kienté district (Poyang Lake District), where the feeding is probably good and plentiful, are somewhat larger than those from further east (*i. e.* Chinkiang and Ning-koufu districts).

My own experience in the field while hunting wild pigs goes to show that there is a great deal of individual variation amongst these animals, some being larger and heavier, though younger, than others. Other sportsmen and hunters, natives as well as European, have informed me that their experience is the same as mine.

As the specimen from Chinkiang was the first to be described, the name *paludosus*[*] must stand for the species occurring in the Yang-tze Valley. *Chirodontus* and other names were mentioned earlier in Heude's publications, but without descriptions. That the Yang-tze pig is not *Sus leucomystax* T. et S., to which species it was originally referred by Swinhoe[†], is certain from a comparison of Heude's specimens with a skull of about the same size, wrongly labelled *S. nipponicus*, from Central Japan. The skulls of the Yang-tze pigs are not only considerably larger than this specimen from Japan, but are proportionately much longer. It is interesting to note, however, that the Yang-tze pigs, in common with most of the pigs in China, have the peculiar whisker-like white patch on the cheek, which gives its name to the Japanese pig *S. leucomystax*.

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[*] Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome iii. p. 193.

[†] P. Z. S. Lond. 1870, pp. 639, 640.

2. Sus moupinensis M.-Edw.

In comparing the three adult male skulls from Shensi, labelled *S. oryodontus*, *S. laticeps*, and *S. curtidens* respectively, with each other I can find little grounds for separating them. All three were collected in 1883 by the same collector, M. Vidi, and, as there are no data to the contrary, one must presume from the same locality in the region of the Upper Han River, S. Shensi.

Compared with the type of *S. paludosus* the Shensi skulls are all smaller and proportionately shorter and broader – in fact, the broadest of the three (*S. laticeps*) is actually a few millimetres wider than the Yang-tze skull, though it is fully 4·5 centimetres shorter. As, however, no description accompanies any of the three names *oryodontus*, *laticeps*, and *curtidens*, while the specimens appear to agree with Milne-Edwards' *Sus moupinensis* from further west, I should suggest considering the Shensi pigs as belonging to that species, till further and more reliable data as to their representing a distinct form are forthcoming. Indeed, Heude himself applied this name to a skull of a sow from the same district from which the other Shensi skulls came. Mr. Gerrit S. Miller has referred a specimen of a wild boar shot by me near Yen-an-fu in North-Central Shensi to Milne Edwards's species.

It is interesting to note that the wild pigs from Shansi also have wide skulls, and specimens sent by me from the Ning-wu district in the west of that Province to the Smithsonian Institution have been determined by Mr. Miller as *S. moupinensis*. An old boar examined by me in 1910 gave the following skull-measurements :—

Condylo-basal length	395 mm.
Zygomatic width	175 mm.
Width across postorbital processes of frontals	127 mm.

These measurements show a greater proportional width than an even larger skull from Chinkiang secured December 1915 by Mr. A. H. Rasmussen, whose property it remains, which measured :—

Condylo-basal length	400 mm.
Zygomatic width	166 mm.
Width across postorbital processes of frontals..............................	110 mm.

It will be noticed, however, that in this comparative breadth of skull the Shansi pig is intermediate between the Shensi and Yang-tze species: for, whereas the skull of the Shansi pig is broader than that of the Yang-tze pig, by nearly a centimetre, it is only half a centimetre shorter, while the skull of the Shensi pig that was broader than that of the Yang-tze pig was some four and a half centimetres shorter.

For this reason, and also because of its geographical position, it being entirely cut off from the Shensi and Moupin species by the Yellow River, the Shansi pig would appear to be a distinct form. It certainly does not belong to the Manchurian species, which is a very much larger animal with a proportionately much longer and narrower skull.

3. Sus gigas Heude.

One was confronted with some difficulties in comparing the pigs from Vladivostok, the Ussuri Valley, and the Sungari Valley. The two skulls from Vladivostok were of adult males in good condition, that from the Ussuri Valley being of a younger male with the cranium missing and that from the Sungari Valley being of a young female.

However, considering that these skulls were all Heude had to go upon in creating his three species, there seems to be no reason why the specimens should not be used legitimately as a basis for a reconsideration of his deductions. Considering the great individual variation that occurs amongst pigs of the same species, Heude was hardly justified in creating these three species, when it is also considered that the regions from which the specimens in question were secured are topographically identical. The Primorsk or Maritime Province in the vicinity of Vladivostok, the Ussuri Valley, and the source and upper, as well as the lower, reaches of the Sungari, form one more or less continuous forest spreading over low hills and marshy valleys.

Compared with the Yang-tze skulls, the Vladivostok skulls were distinguishable at once by their enormous size and proportionate narrowness. What there is of the Ussuri skull also shows this very plainly, while the narrowness of the Sungari skull (imm. ♀) when compared with a small female skull of the Yang-tze species is noticeable.

I could not discover specimens of *S. canescens* or *S. mandchuricus* in the collection, but, as Heude says that specimens were bought in the Peking market, having come from Mukden, they must originally have been secured in the Manchurian forests, either in the vicinity of Harbin or well to the east of Mukden itself. In any case they would be inhabitants of the same topographical and faunal area as the other three species. I have no doubt that there is in this area but the one species of pig which must bear the name *Sus gigas**, as it was the earliest given. This is a good name, not only because of its priority, but because it suggests the great size of the species, and also because the type-skull and the topotypical one are complete and fully adult.

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* Mém. conc. l'Hist. Nat. l'Emp. Chin. tome iii. p. 189.

The two skulls from Vladivostok and that from the Ussuri exceed in size any skulls hitherto obtained in China proper, and also show a wonderful tusk-development. The lower tusk of the smaller of the two Vladivostok skulls measured 10″, notwithstanding the fact that it was broken off at the tip, while the tusk of the larger skull must have exceeded this considerably, but I could not extract it for measurement. However, it measured $1\frac{5}{8}$″ in diameter. The largest tusks from China that I have measured were 10″ in length (not broken at all) and $1\frac{1}{4}$″ in diameter. None of the fine skulls in Heude's collection from China bore tusks over $8\frac{1}{2}$″ in length or $1\frac{1}{8}$″ in diameter.

In regard to the Manchurian pigs Heude says (page 111, vol. iii.) that the eastern forms partake somewhat of the dental characteristics of *S. scrofa*, but differ more widely as one goes westwards. This may be so, but, as I have pointed out, his specimens *canescens* and *mandchuricus* in all probability come from the same forest area as his specimens *ussuricus*. *songaricus*, and *gigas*—themselves representing but the one species.

4. SUS COREANUS Heude[*].

I should consider this a valid species. Its skull is altogether smaller than that of the Manchurian species, and is also proportionately shorter than that of *S. paludosus*, the Yang-tze form, but it is larger and proportionately longer than the Japanese *S. leucomystax*.

5. SUS MELES Heude[†].

Represented by a single skull from Kuangsi, South China, this species I should have no hesitation in confirming, were it not for the fact that no description accompanies the name. The skull has shorter nasals and a much broader forehead than the type of *S. paludosus*, besides being much smaller. A remarkable difference occurs in the upper tooth-row, where there is one premolar less than in any of the foregoing species. The skull is not so short and heavy as that of the specimen from Japan.

Besides the fine series of adult male skulls mentioned above, there are several adult female and young male skulls in the collection. A female skull labelled *S. moupinensis* from South Shensi (*i. e.* somewhere in the region where the other Shensi skulls came from) differs but little from a female skull from Kienté, though the latter is a little higher in the crest, and is also slightly longer and narrower. The height of the crest, however, is confined to this single specimen, all the other female skulls in the collection being the same in this respect as the South Shensi skull.

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[*] Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome iii. p. 191.

[†] Not described in Mém. conc. l'Hist. Nat. de l'Emp. Chin., though the name is given.

Colour.—As regards the colour of the various species I could learn nothing from Heude's collection, as I could not find any skins. However, I had the opportunity of looking over several skins in the possession of Mr. A. H. Rasmussen of Chinkiang. All those he showed me had been secured by himself in the vicinity. I was struck by the fact that though the underwool in those pelts was brown and the long hairs black, yet the latter had such a large portion of their length white or cream that it gave the whole skin a very light appearance. This characteristic occurs only in extremely old specimens of the pigs from Shansi. There the young males are brown and the old males nearly black. Very young specimens of the Yang-tze species have the coat of a rich chestnut-colour, which is not the case with the Shansi species. I have been told by Mr. Lewis Broome, who has shot wild boars in Shansi as well as in Manchuria, that those from Manchuria are even blacker than the Shansi ones. The white whisker-like patch on the cheek is more pronounced in *S. paludosus* than in the pigs from Shansi.

From the foregoing comparisons and notes it would seem that there are the following distinct species of Pig represented in Père Heude's collection, all others given in his papers and descriptions being invalid under the present generally accepted system of classification:—

1. *Sus paludosus* Heude. Yang-tze Valley. Type from Chinkiang, Kiang-su, China. No number.
2. *Sus moupinensis* M.-Edw. The Upper Han, South Shensi, also Ssuchuan and Kansu, China.
3. *Sus gigas* Heude. Forests of Manchuria and the Primorsk, Type from Vladivostok. No number.
4. *Sus coreanus* Heude. Fusan, Corea. Type from Fusan. No number.
5. *Sus meles* Heude. Kuangsi, South China. Type same. No number or description, but a distinct species.
6. *Sus leucomystax* T. et S. Central Japan (specimen in Heude's collection wrongly named *S. nipponicus*).

Genus CERVUS.

The *Cervus-sika* group of the genus *Cervus* is represented in the Sikawei Museum by a fine series of skulls and skins, but as the latter are now in a poor condition from the ravages of insects and the effects of damp, the following notes and observations are based chiefly upon an examination of the skulls.

The range of the Sika in China was formerly very extensive, but, owing to the increasing demand for "hartshorn," made from the horns, when in velvet, of this deer, the animal is practically extinct in most places and is nowhere plentiful.

The Sika is known to occur in a few isolated regions in North-west Shansi, in the Imperial Hunting-grounds north-east of Peking in Chihli, in the more remote parts of the Manchurian forests, in North Corea, in one or two isolated areas along the Lower Yang-tze, and probably also in Tonkin and parts of South China.

Heude's collection contains specimens from the Sungari Valley and Mukden in Manchuria, Vladivostok in the Maritime Province or Primorsk, Kienté, Tonglieou and Ning-kuo-fu on the Yang-tze, Phu-lang-thuang in Tonkin and Tsing-lo-hsien in Shansi.

Following is a list of Heude's species, whose skulls were examined, giving Heude's names together with the localities as found on the labels:—

1.	*Cervus*	*imperialis.*	Songari Valley, Manchuria.
2.	„	*microspilus.*	Mukden, Manchuria.
3.	„	*dybowskii.*	Vladivostok, Primorsk.
4.	„	*manchuricus.*	Mukden, Manchuria.
5.	„	*cycloserus.*	Kienté, Yang-tze Valley, Anhui; also Tong-lieou, Yang-tze, Anhui.
6.	„	*brachyrhinus.*	
7.	„	*lachrymosus.*	
8.	„	*pouvrelianus.*	
9.	„	*joretianus.*	
10.	„	*frinianus.*	
11.	„	*grilloanus.*	
12.	„	*rivierianus.*	Tong-lieou, Yang-tze, Anhui.
13.	„	(name illegible).	Kienté, Yang-tze, Anhui.
14.	„	*andreanus.*	Ning-kuo-fu, Anhui.
15.	„	*dugennianus.*	Phu-lang-thuang. Tonkin.
16.	„	*grassianus.*	(Pair of horns only) Tching-lo-hsien, Shansi.

An examination of the skulls assigned by Heude to the first four species in the list, *i. e.* those from the forested areas of Manchuria and adjacent Primorsk, convinced me that these forested areas are inhabited at the very most by but two species, namely, *Cervus mantchuricus* Swin.* and *Cervus dybowskii* Tacz. †

The skull of the adult male labelled *imperialis* from the Sungari Valley was practically identical with the skull of an adult male labelled *dybowskii* from Vladivostok, the only noticeable difference being that the former (*imperialis*) was shorter and broader than the latter (*dybowskii*). Two adult female skulls of *imperialis* and *dybowskii* showed just the reverse, the *imperialis* one being longer and proportionately narrower than the *dybowskii* one. However, this lengthening out of the skull seems to be a characteristic of age, for in both cases it was the older skull that was the longer. From this it would appear that the Sika from the Sungari Valley is identical with that from the Primorsk, but the latter has been described as having a pure white muzzle, which is not the case with the former, so that the two are probably distinct.

The skull of a young male labelled *microspilus* from Mukden was very similar to that of a young male labelled *mandchuricus* also from Mukden, though the former, the younger, was shorter proportionately than the latter. In connection with these two specimens it should be noted that in all probability they did not come from the immediate vicinity of Mukden, but were brought there for sale by native hunters or were kept in captivity there. The nearest forest country suitable for these deer to inhabit, even as long ago as 1899, could only have been a hundred miles or so to the east on the borders of the Fengtien (formerly Shenking) Province.

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* P. Z. S. 1864, pp. 168, 169.

† P. Z. S. 1876, p. 123.

The name *Cervus mantchuricus* Swin. undoubtedly applies to the species inhabiting North and Central Manchuria, and *Cervus dybowskii* to the species inhabiting the Primorsk. To which of these two species, if either, the North Corean Sika belongs cannot be determined here.

The specimen labelled *Cervus grassianus* from Tching-lo-hsien (Tsing-lo Hsien), Shansi, consisting of a pair of horns only, afforded but little scope for comparison with the other specimens in the Museum, but it was noticeable that the horns were large and heavy, resembling those from Manchuria rather than those from the Yang-tze.

Whether the Shansi Sika is referable to Milne Edwards's *Cervus mandarinus* from the Imperial Hunting-park, Chihli, I cannot say. No really good specimens of this deer (from Shansi) have been secured. I have seen summer and winter skins, the former being a fine rufous colour, very much like that of the North China roe (*Capreolus bedfordi*) in summer, studded with white spots, and having a dark median-dorsal line, while the latter is grey, much lighter than Milne-Edwards's figure, with dark median-dorsal line. The horns also of this deer attain a large size, and I have seen considerably larger specimens than those in Heude's collection.

In dealing with skulls from the Yang-tze I laid out the whole series and compared them with each other and with those from Manchuria and Tonkin. I could detect no difference that might be called specific between the ten species described by Heude and represented in the series before me (Nos. 5 to 14 inclusive in the list given above). Such differences as did exist could be attributed to the varying ages of the specimens or to perfectly natural individual variation. The variations in length and breadth, such as were noticed with the Manchurian skulls, were again noticeable here, and as before coincided with the varying ages of the animals.

Of the three male skulls with well-developed horns, labelled *C. pourrelianus*, *C. brachyrhinus*, and *C. cycloserus*, the first had the widest spread and the best development, though it fell considerably short of the Manchurian and Shansi horns.

A single specimen of a fully adult male labelled *C. andreanus* from Ning-kuo-fu had well-developed horns, which, however, were smaller and lighter than those of any of the three specimens just mentioned from Kienté, though they agreed in size with those of some males from Kienté of about the same age.

C. rivierianus was represented by a single female skull from Tong-lieou, which was indistinguishable, except that it was younger and therefore slightly shorter, from the skulls of other females from Kienté. The skull of a young male with small horns labelled *C. grilloanus* bears a label similar to that upon the *C. rivierianus* skull, and was collected by the same person at the same place (Tong lieou), apparently at the same time, while the skull of an adult male with horns cut away, labelled *C. grilloanus*, was collected at Kienté Central.

Many of the labels on the skulls bear evidence that the specific names have been erased and rewritten several times, giving clear proof of the doubt and confusion existing in the mind of Heude himself as to which of his specimens belonged to which of his species.

Under these circumstances I fail to find any reason for admitting the existence of more than one species of Sika in the Yang-tze Valley, and therefore I would suggest that, until further and more substantial evidence than the shape of deers' horns (capable, as is well known, of almost unlimited minor variation in a single species), which seems to have been the chief characteristic used by Heude in his classification, is forthcoming, the whole of his names for the Yang-tze Sikas be suppressed in favour of Swinhoe's much earlier name *kopschi* *.

As an example of the extraordinary state of confusion that exists amongst Heude's specimens was a skull of a fine fully adult male Sika with good horn-development. On the label of the skull the name *oxycephalus* has been scratched out and replaced by another which is illegible. The word *type* was also written on the label. This skull was not specifically different from any of the other Kienté skulls.

CERVUS DUGENNIANUS Heude †.

The two skulls from Phu-lang-thuang, Tonkin, I found to closely resemble those from the Yang-tze, but on account of the geographical position of the species, and without going into any further details, I should consider it valid.

I could not find any specimens of the following species named by Heude: --

Cervus cyclorhinus. Shantung.
,, *hyemalys*. North Shantung.
,, *ignotus*. Central China.
,, *yuanus*. Found in the gravel in caves near Tong-lieou, facing An-king-fu.

Regarding the first two I very much doubt if Sika have occurred in a wild state in Shantung for hundreds of years. That province is closely settled and contains no forested regions suitable to the requirements of these deer. The two specimens referred to by Heude must have been kept in captivity in some temple, or else had been brought for sale as game from some other province.

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* P. Z. S. 1873, p. 574.

† Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 156.

Cervus ignotus might be the illegible name on the specimen (No. 13 in the list) referred to above, while *Cervus yuanus*, supposed by Heude to be an extinct species, may or may not belong to the same species as the rest of the Yang-tze Sikas.

Thus, I propose dividing the Sikas inhabiting China, Manchuria, and the Primorsk or Maritime Province into the following valid species :—

1. *Cervus kopschi* Swin. Yang-tze Valley.
2. „ *mantchuricus* Swin. Ussuri Basin to the plains of Western Manchuria.
3. „ *dybowskii* Tacz. The Primorsk.
4. „ *mandarinus* M.-Edw. Chihli and North China.
5. „ *dugennianus* Heude. Tonkin, S. China.

The Sika that inhabits Shansi might temporarily be referred to *C. mandarinus*, while that occurring in Northern Corea might be placed with *C. mantchuricus* till specimens have been secured for comparison and description.

Genus Capricornis.

In going over the collection of Serows in the Museum I examined 26 skulls, with a number of the corresponding skins. Altogether I found 24 species as follows :—

1.	*Capricornis*	*brachyrhinus.*	1 skull.	All collected by Farges at Tchen-kou-tung in N.E. Ssuchuan.
2.	„	*chrysochætes.*	1 „	
3.	„	*erythropygius.*	1 „	
4.	„	*fargesianus.*	2 skulls.	
5.	„	*longicornis.*	1 skull.	
6.	„	*platyrhinus.*	1 „	
7.	„	*cornutus.*	2 skulls.	West Ssuchuan and Moupin.
8.	„	*nasutus.*	1 skull.	Moupin, collected by M. Briand.
9.	„	*ungulosus.*	1 „	
10.	„	*microdontus.*	1 „	
11.	„	*vidianus.*	1 „	Han-chang-fu, Shensi.
12.	„	*collasinus.*	1 „	Kuang-tung (Canton Province).
13.	„	*argyrochætes.*	1 „	Chao-hing-fu (Hsao-shing-fu), Chekiang.
14.	„	*maxillaris.*	1 „	
15.	„	*maritimus.*	1 „	Along Bay, Tonkin.
16.	„	*benetianus.*	1 „	
17.	„	*bridannellianus.*	1 „	
18.	„	*rocherianus.*	1 „	
19.	„	*copusianus.*	1 „	
20.	„	*brossodianus.*	1 „	
21.	„	*achardianus.*	1 „	
22.	„	*marcolinus.*	1 „	Kechen, Tonkin.
23.	„	*gendrelianus.*	1 „	Keso, Tonkin.
24.	„	*berthetianus.*	1 „	Keso, Tonkin.

C. morianus I was unable to find in the collection.

A look at the map of China will show that the places where the above specimens were collected can be arranged in five areas, more or less distant and separated from one another, ranging from the coastal regions to the border of Thibet.

These are: —

(*a*) Chekiang Province.
(*b*) Kuang-tung (Canton) Province.
(*c*) Tonkin.
(*d*) North-eastern Ssuchuan and South Shensi.
(*e*) West Ssuchuan and Moupin.

Whether the last two are really separable is doubtful, for they consist of much the same sort of country, *i. e.* high, precipitous, and well-forested mountains.

In examining the skulls, however, I found that they could be divided up according to the above divisions.

I first examined the large series of fine skulls from the Chen-kou-ting district of North-eastern Ssuchuan, close to the borders of Shensi and Hupei. They were all collected by M. Farges during the year 1894. I found it impossible to separate them one from the other, the whole series showing certain well-defined characteristics. Most noticeable of these was the uniformly great length of the horns, which sloped sharply back, were well curved, and were closely set, the tips having a tendency to point inward. Though the bases of the horns were annulated and there were the usual narrow longitudinal grooves, yet these were not very pronounced, and the horns had a smooth shiny appearance.

Turning to the skins corresponding with these skulls, I was at first struck by the great variation in colour, but on a closer examination I found that this was due entirely to the quantity of under-wool present. Thus some pelts were of a grey-buff colour, which was due to a great abundance of under-wool, through which long coarse black hairs protruded, while other pelts were entirely black, having no under-wool at all, the hairs being coarse and short. There were all stages between these two extremes. It is obvious from this that the varying colours as described by Heude, and upon which he bases to a large extent his classification, are due entirely to seasonal changes, mid-winter specimens being light and mid-summer specimens dark.

An examination of the manes, which were pretty well developed in all the specimens, showed that in nearly all of them white or cream hairs were present, in some greatly predominating over the black and chestnut hairs, in others scarcely noticeable on account of their scarcity. There seems to be little connection between the lightness or otherwise of the mane with the lightness of the coat generally, and I came to the conclusion, finally, that the white mane is a characteristic of age more than of season. At the same time it may be a characteristic which varies in individuals. However that may be, it seems pretty certain that the presence or absence of the white mane is not a specific characteristic. I also noticed that the rusty brown of the legs seemed a somewhat variable characteristic, disappearing almost altogether in the winter specimens, and being better developed in some summer specimens than in others.

A comparison of the series of skulls from Moupin including the one from W. Ssuchuan, with the series from Chen-kou-ting at once revealed a difference, permanent throughout the series (six specimens), in the horns. Those of the Moupin series were much more deeply ringed and longitudinally grooved, and at the same time were shorter and had a greater tendency to spread. The longest horn in the Moupin series measured 9″ as compared with 10¼″ in the Chen-kou-ting series. The widest spread occurred in the two specimens labelled *cornutus* from Moupin and West Ssuchuan.

In other respects there were no really specific differences between the specimens of the two series.

After my examination of this large series of skulls and skins, finding as I did that the individuals were subject to considerable variation in the predominance of the white hairs of the mane over the chestnut and black hairs, and also that the rusty colour on the legs is more intense in summer and more inclined to greyness in the winter, I cannot agree with the late Mr. Lydekker's opinion, expressed in his paper (P. Z. S. 1908, p. 942), that there are two species of Serow, one dark-maned and the other light maned, occupying the same localities in West China, but would adhere more to the opinion that there are two species, both with a tendency to have the white mane, one occupying Western and North-western Ssuchuan, the other a more easterly region.

1 & 2. CAPRICORNIS MILNE-EDWARDSI David and C. VIDIANUS Heude.

To the former I would give David's name of *Capricornis milne-edwardsi*, and to the latter Heude's name of *vidianus*, as it is under this name that the first description of the N.E. Ssuchuan and Shensi Serows occur (tome iii. p. 154 of his Memoires).

3. CAPRICORNIS ARGYROCHÆTES Heude.

The name *argyrochætes* cannot be given to the Ssuchuan and West China Serows, as it belongs to the Chekiang Serow, which is certainly distinct from either of the above. The rusty brown of the legs, for instance, is distinctly lighter, while the mane is creamy brown, due to a greater prevalence of chestnut hairs. It is interesting to note, however, that here again the presence of the light mane is not a permanent character, for a mounted head in the collection from Chao-hing (Shao-shing-fu, Chekiang) showed no trace of a light mane. This specimen had horns like the Chen-kou-ting ones, but smaller and with a wider spread. The name *argyrochætes* seems to have been given to the Chekiang species in 1888 by Heude, the description appearing in tome ii. p. 228 of his Mém. conc. l'Hist. de l'Emp. Chin.

4. Capricornis collasinus Heude.

Heude's species *collasinus* is represented in the collection by a fragment of a skull with one very long horn (9¼″) attached, which bears a resemblance to those from Chen-kou ting. Heude had the complete skull reconstructed in a drawing which he has reproduced on pl. xlii. figs. 5–8 of tome iv. of his Memoires. The geographical position of this Serow would almost preclude its being placed with the Chen-kou-ting specimens, and, as the horn differs markedly from those of the specimens from Tonkin, it would seem advisable to let the name remain till material for better comparison is forthcoming. The description, if it may be called such, appears on p. 211, tome iv. of Mém. etc.

5. Capricornis rocherianus Heude.

Finally, there remain the large series of skulls from Along Bay (Baie de Halong) and Keso in Tonkin to be dealt with. With the exception of the specimen labelled *C. berthetianus* from Keso, all the skulls in this series are decidedly smaller than those of the Ssuchuan series. They are also proportionately deeper, including the *berthetianus* specimen. The horns of all the skulls are smaller and shorter than any of the Ssuchuan or other Chinese skulls. Added to these skull and horn differences is the fact that the colour of the coat differs markedly from the other species, it being black, inclined to blue-black, with a distinctly brown face (more so than in the other species) and creamy-white legs. Besides this, there is an entire absence of any white or cream mane, so that the animal is certainly distinct from the other Chinese forms. Nevertheless, there is nothing in the series to justify Heude's division of it into ten species. The name *rocherianus* is the first which has a description, and as there seems to be no real difference between the others, it should be applied to the whole series. The skull labelled thus is typical of the others, and was collected as far back as 1887 by M. Rocher*. The rest of the names for the Tonkin specimens should be considered invalid.

Thus, Heude's twenty-four species and David's one may be reduced to the following five:—

1. *Capricornis argyrochates* Heude. The Province of Chekiang, S.E. China.
2. „ *vidianus* Heude. The region of N.E. Ssuchuan and S. Shensi, Central China.
3. „ *milne-edwardsi* David. W. Ssuchuan, N.W. Ssuchuan and S.W. Kansu, W. China.
4. „ *collasinus* Heude. Kuang-tung Province, S. China.
5. „ *rocherianus* Heude. Tonkin, S.W. China.

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* Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 225, pl. xxx.

Genus NEMORHÆDUS *.

There are some thirty-two (32) specimens of Goral in the collection, representing, according to Heude, seventeen (17) species as follows:—

1.	*Kemas cinereus.*	2 specimens.	Moupin.
2.	,, *griseus.*	4 ,,	,,
3.	,, *pinchonianus.*	1 specimen.	W. Ssuchuan.
4.	,, *xanthodeiros.*	1 ,,	,,
5.	,, *fargesianus.*	6 specimens.	Chen-kou-ting.
6.	,, *curvicornis.*	2 ,,	,, ,,
7.	,, *initialis.*	3 ,,	,, ,,
8.	,, *iodinus.*	1 specimen.	,, ,,
9.	,, *versicolor.*	2 specimens.	,, ,,
10.	,, *niger.*	1 specimen.	,, ,,
11.	,, *galeanus.*	2 specimens.	Mountains of Yu-ho, Shensi.
12.	,, *vidianus.*	2 ,,	,, ,, S. Shensi, and Si-ngan-fu.
13.	,, *fantozatianus.*	1 specimen.	N.W. Houpei (Hupei).
14.	,, *henryanus.*	1 ,,	Yi-chang (I-chang).
15.	,, *aldrigeanus.*	1 ,,	,, ,,
16.	,, *arnouxianus.*	1 ,,	Ki-hsien, Chekiang.
17.	,, *raddeanus.*	1 ,,	Oussouri (Ussuri), Manchuria.

The general areas from which the above specimens were obtained are separable in much the same way as those from which the Serows were collected, viz.:—

(*a*) Chekiang Province.
(*b*) Yichang, on the Yang-tze, Central Hupei.
(*c*) N.E. Ssuchuan, S. Shensi, and N.E. Hupei.
(*d*) Moupin and W. Ssuchuan.
(*e*) Manchuria (Northern and Western).

Besides these areas, Gorals are also to be found in Chihli and North Shansi on the Mongolian frontier, in neither of which nor in Manchuria are Serows known to occur.

It will be seen that by far the largest number (15) of the specimens in the collection come from Chen-kou-ting in N.E. Ssuchuan. A careful examination showed that they could not be separated one from the other—at least, on the evidence of their skulls. As regards the coloration, which, as with the Serows, seems to have been one of the chief points in Heude's classification, it must be noted that there is considerable seasonal variation in the pelts of Gorals. I could not get hold of the skins of Heude's specimens, however, so am not in a position to say definitely whether he did or did not fall into the mistake of considering seasonal differences as specific ones, but an examination of the skulls themselves and also his coloured plates, together with my own experience in the field regarding the extreme variability of Gorals' pelts during the seasons, lead me to suspect that he did.

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* By Heude this genus was named *Kemas*.

1. **Nemorhædus niger** Heude*.

The skulls of the Chen-kou-ting series in their thin smallish horns and general shape and size agreed very closely with the specimens labelled *griseus*, of which there were four in the collection from Moupin (N.E. Ssuchuan on the Thibetan border).

The specimens from Shensi and N.W. Hupei also resembled the Chen-kou-ting specimens so closely that I should not hesitate to place them together. Whether these and the Chen-kou ting specimens are separable from *griseus* is an open question, though I feel inclined to allow it on the grounds of their geographical distribution—adopting for them the name of *niger* as the first one of a Goral from this general district having a regular description annexed. It is worth noting that the specimens labelled *vidianus*, from Shensi, have unusually long horns, the longest measurement being 7″. I have a single horn from the same district which measures 7½″ in length. The length of this horn is doubtless only a local variation, and certainly fails to justify the creation of a distinct species.

2. **Nemorhædus griseus** Milne-Edwards.

The two specimens from W. Ssuchuan, labelled *pinchonianus* and *xanthodeiros* respectively, were so like the skulls of *griseus* as to be indistinguishable, and, as they came from practically the same district, should, I think, be included in that species.

3. **Nemorhædus cinereus** Milne-Edwards.

Very different were the two skulls representing *cinereus* from all the other skulls. They were heavier and larger with a wider forehead, while the horns were narrower and more closely set together.

4. **Nemorhædus henryanus** Heude †.

The two specimens marked *henryanus* and *aldrigeanus* from Yi-chang closely resembled each other, but differed from the Ssuchuan species in being wider across the cheek-bones, with wider palate, and distinctly larger eye-sockets.

It should be noticed that the N.W. Hupei specimen *fantozatianus* had a slightly wider palate than the Chen-kou-ting specimens, but it was only in this that it resembled those from Yi-chang.

As the first description of the I-chang Goral appears under the name of *henryanus*, that name is the valid one.

5. **Nemorhædus arnouxianus** Heude ‡.

The specimen from Chekiang, *arnouxianus*, is undoubtedly a distinct species, its habitat, which is separated by a wide stretch of country (apparently uninhabited by Gorals) from the habitats of the other species, alone warranting this. A good description is given by Heude in tome ii. p. 239.

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* Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 241, pl. xxxviii. fig. 12, and pl. xxxix. figs. 2–6.

† Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 244, pl. xxxiv.

‡ Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 239.

6. NEMORHÆDUS RADDEANUS Heude*.

The Goral from the Ussuri is undoubtedly a valid species. The single skull in the collection, though of an immature specimen, was slightly larger than any of the other skulls. Specimens which I myself have collected in Manchuria (I-mien-po, N. Kirin) show a marked difference in colour from others collected by me in Chihli and North Shansi, which are undoubtedly referable to Milne-Edwards's *caudatus*. The Manchurian specimens are larger and greyer than *caudatus*, and also have a long white tail instead of black as in *caudatus*. The median-dorsal line is broad, dark, and well-defined, having a tendency to continue down the face.

7. NEMORHÆDUS CAUDATUS Milne-Edwards.

That *caudatus*, of which the Sikawei Museum has no representative, is a good species needs no proof. It inhabits high mountainous regions which are cut off by wide intervening spaces, uninhabited by any form of Goral, from the Shensi, Ssuchuan, and Hupei species.

Thus, it may be claimed that there are the following seven valid species of Goral in China and Manchuria:—

1. *Nemorhædus cinereus* M.-Edw. Moupin.
2. ,, *griseus* M.-Edw. Moupin and W. Ssuchuan.
3. ,, *niger* Heude. N.E. Ssuchaun, S. Shensi, and N.W. Hupei.
4. ,, *henryanus* Heude. I-chang, Central Hupei.
5. ,, *arnouxianus* Heude. Chekiang.
6. ,, *caudatus* M.-Edw. N. Shansi and Chihli.
7. ,, *raddeanus* Heude. Manchuria.

Mém. conc. l'Hist. Nat. de l'Emp. Chin. tome ii. p. 240, pl. xxxv.

3. Report on the Deaths which occurred in the Zoological Gardens during 1916, together with a List of the Blood-Parasites found during the Year. By H. G. PLIMMER, F.R.S., F.Z.S., Professor of Comparative Pathology in the Imperial College of Science and Technology, London, and Pathologist to the Society.

[Received and Read February 6, 1917.]

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On January 1st, 1916, there were 690 mammals, 1989 birds, and 426 reptiles in the Zoological Gardens: during the year 1916, 165 mammals, 545 birds, and 199 reptiles were admitted, making a total for the year of 855 mammals, 2534 birds, and 625 reptiles.

During 1916, 242 mammals, 594 birds, and 179 reptiles have died: that is, a percentage of 28·3 for mammals, 23·4 for birds, and 28·6 for reptiles: the average percentages for the last five years being 27, 23·3, 31·2 respectively.

Out of the total deaths for the year, 1015 in all, 269 occurred in animals which had been less than six months in the Gardens, that is a little more than a fourth of the deaths. It has been found that after six months' residence in the Gardens the death-rate of the animals falls rapidly; so it is assumed that by this time the new arrivals have got used to their new environment, or have died from any diseases of a parasitic kind which they may have brought with them. Of these 269 animals 60 were mammals, 132 were birds, and 77 were reptiles; and, if these be deducted from their respective totals, the death-rate percentage will come out as 21·2 for mammals, 18·1 for birds, and 16·3 for reptiles, the average percentages for the last five years being 17·3, 15·6, 13·8 respectively.

The following Tables show in outline the facts which have been ascertained. Table I. summarizes the actual causes of death in the three groups specified. Amphibia are included under Reptiles.

TABLE I.—Analysis of the Causes of Death.

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following
1. *Microbic or Parasitic Diseases.*				1
Tuberculosis	16	71	1	2
Mycosis	12	29	6	3
Pneumonia	30	53	48	4
Septicaemia	5		1	5
Abscess	2		1	
Empyema	2			
Peritonitis	2	1	.	

TABLE I.—Analysis of the Causes of Death (*continued*).

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
1. ***Microbic or Parasitic Diseases*** (cont.).				
Cystitis	1	...	1	
Leucocytozoa infection	...	1	...	
Acari infection	..	1	...	6
Syngamus infection	..	1	..	
Filariasis	1	...	..	
Ascaridosis	2	...	1	7
2. ***Diseases of Respiratory Organs.***				
Atelectasis	5	.	...	8
Bronchitis	8	.	.	
Broncho-pneumonia	42	.		
Congestion of lungs	3	78	8	
Pleuritis	1	..	..	
3. ***Diseases of the Heart.***				
Degeneration of muscle	1	1	...	
4. ***Diseases of the Liver***				
Hepatitis	...	1	2	
Cirrhosis	4	2	.	
Fatty degeneration	..	3	1	
5. ***Diseases of the Alimentary Tract.***				
Gastro-enteritis	4	2	2	9
Gastric ulceration	2	..		
Enteritis	22	190	14	
Gastritis	...	.	3	
Intestinal obstruction	.	1		
Intussusception	2	..	...	
Prolapse of rectum	1	.		
6. ***Diseases of Urinary and Generative Organs.***				
Nephritis	34	45	5	10
Cystic kidneys		1	.	
Salpingitis	..	1	3	
Extroversion of uterus	1	..	...	
7. ***Various.***				
Carcinoma	3	..	.	11
Sarcoma	2	1	.	12
Leukhæmia	1	..	.	13
Caries of spine	1	...	.	
Spinal curvature	1	.		
Hæmorrhage	...	1	.	
Injuries discovered *post-mortem*	...	1	.	14

Besides those tabulated above,

25 mammals, 85 birds, 7 reptiles, were killed by order or by companions,

1 bird, 37 reptiles, died from malnutrition or starvation,

6 mammals, 22 birds, 38 reptiles were too decomposed for examination,

1 bird was preserved unopened,

completing the total.

In Table I. an analysis is made of the immediate causes of death, but in nearly every case the animals were found to be suffering from other lesions as well. Table II. summarizes these other diseases from which the animals were suffering; and if this Table be taken in conjunction with Table I., a much more accurate estimate of the amount of disease in the Gardens will be arrived at.

TABLE II.—Secondary Diseases found in the animals tabulated in Table I.

Diseases	Mammals	Birds	Reptiles	Reference to Notes following
Tubercle	1			
Mycosis			2	
Pneumonia	2	6		
Pericarditis	1			
Peritonitis	5	2	3	
Abscess	2		1	
Pyorrhœa	3			
Hydatids	1			
Worm infection	1	3	3	
Malaria		4		15
Filaria	1	2		
Hæmogregarines			4	
Leucocytozoa		1		
Stomatitis			3	16
Bronchitis	6			
Broncho pneumonia	11			
Congestion of lungs	20	162	16	
Œdema of lungs	1	103	8	
Collapsed lungs	1			
Degeneration of heart	4	1	1	
Hypertrophy of heart	1			
Hepatitis		1		
Pericarditis		5		17
Atheroma of aorta	3	4		
Aneurism	1			18
Fatty degeneration of liver	17	41	5	
Cirrhosis of liver	3	1	1	
Cholecystitis	1			
Gastritis	3		1	
Gastric ulceration	9			
Gastro-enteritis	5		4	
Enteritis	28	90	14	
Intestinal obstruction		1		
Nephritis	36	78	7	
Cystic kidneys	1	2		
Salpingitis		2		
Ascites			2	
Angioma	1			
Lardaceous disease	1			
Retained fœtus	1			
Rickets	2			
Uræmia	1			19
Injuries	1	5		

Table III shows, in still further detail, the distribution of the immediate causes of death, shown in Table I., amongst the various large orders of mammals.

TABLE III.—The Distribution of Diseases causing Death amongst the principal Orders of Mammals.

Diseases.	Primates.	Carnivora.	Rodentia.	Ungulata.	Edentata.	Marsupialia
Tuberculosis	7	4	1	2		2
Mycosis	1		1	6		4
Pneumonia	11	7	9	1		2
Septicæmia		3	1			1
Abscess	1		1			
Empyema		2		...		
Peritonitis	1		1			
Cystitis		1				
Filariasis			1			
Ascaridosis		2				
Atelectasis		4		1		
Bronchitis	2	2	3	1		
Broncho-pneumonia	21	9	8	4		
Congestion of lungs			2	1		
Pleuritis					1	
Degeneration of heart	1					
Cirrhosis of liver		2				2
Gastro-enteritis	3	1				
Gastric ulceration	1		1			
Enteritis	8	2	9	2		1
Intussusception	2					
Prolapse of rectum						1
Nephritis	12	10	4	5	2	1
Extroversion of uterus			1			
Carcinoma		2	1			
Sarcoma		1	1			
Leukhæmia		1				
Caries of spine	1					
Curvature of spine	1					

The following, Table IV., shows the number of Deaths from those Diseases of the greatest numerical importance for the last four years. the total number of animals of each class is placed above, so that a proper comparison can be made.

TABLE IV

Mammals.

Year	1913.	1914.	1915.	1916.
Total number of mammals	1272	1261	1013	855
Tuberculosis	31	12	6	16
Mycosis	8	[illegible]	10	12
Pneumonia	34	53	48	30
Bronchitis	6	11	10	8
Broncho-pneumonia	25	21	34	42
Congestion of lungs	14	11	13	3
Gastro-enteritis	7	16	11	4
Enteritis	33	33	25	22
Nephritis	90	66	40	34

Birds

	1913.	1914.	1915.	1916.
Total number of birds	3518	3610	3210	2534
Tuberculosis	101	113	60	71
Mycosis	75	88	32	23
Pneumonia	89	118	70	53
Congestion of lungs	98	133	130	78
Enteritis	148	169	150	190
Nephritis	135	129	81	45

Reptiles

	1913.	1914.	1915.	1916.
Total number of reptiles	1169	1015	608	625
Tuberculosis	6	4	2	1
Mycosis	1	10	6	6
Pneumonia	138	69	34	48
Congestion of lungs	13	19	11	8
Enteritis	15	17	8	14

BLOOD-PARASITES.

During the year the blood of every animal mentioned in the foregoing lists has been examined, with the result that parasites have been found in 24 cases, in 13 species for the first time.

They have been distributed as follows:—

Filariæ. In 3 mammals, in all for the first time.
In 3 birds, in all for the first time.

Malaria { *Hæmoproteus danilewskyi.* In 5 birds, in 3 species for the first time.
Plasmodium præcox. In 1 bird for the first time.

Leucocytozoa. In 3 birds; in 2 species for the first time.

Hæmogregarines. In 9 reptiles, in 3 species for the first time.

Intestinal organisms. In 1 reptile.

The particulars of the blood-parasites are as follows:—

Filariæ.

Mammals.

Found for the first time in:	HABITAT.	TYPE.
Bay Lynx (*Felis rufa*)	Mexico.	Long.
Hamster (*Cricetulus obscurus*)	Mongolia.	Long, thick.
Grison (*Grison allamandi*)	Argentina.	Long.

Birds.

Scarlet Cardinal (*Cardinalis phœniceus*).	Venezuela.	

Found for the first time in:

Black-headed Sugar-Bird (*Chlorophanes spiza*).	Brazil.	Short, thick.
Gay's Finch (*Phrygilus gayi*)	Chili.	Long, no capsule.

Malaria.

Birds.

Hæmoproteus danilewskyi.

Paradise Whydah Bird (*Vidua paradisea*).	W. Africa.
Shama (*Cittocincla macrura*)	India.

Found for the first time in:

Rose Finch (*Propasser rhodochrous*)	India.
Yellow-backed Lory (*Lorius flavopalliatus*).	Batchiam.
Scarlet Cardinal (*Cardinalis phœniceus*).	Venezuela.

Plasmodium præcox.

Found for the first time in:

Pitta (*Pitta novæ-guineæ*)	Aru Islands.

Leucocytozoa.

Birds.

Scops Owl (*Scops giu*)	Captured at sea.

Found for the first time in:

Rose Finch (*Propasser rhodochrous*)	India.
Carrion Crow (*Corvus corone*)	Europe.

Hæmogregarines.

Reptiles.

Common Boa (*Boa constrictor*)	S. America.
King Snake (*Coronella getula*)	N. America.
Banded-tailed Tree-Snake (*Leptophis viperinus*).	Europe.
Indian Python (*Python molurus*)	India.
Eyed Lizard (*Lacerta ocellata*)	Europe.

Found for the first time in:	HABITAT.	TYPE.
Annulated Snake (*Leptodira annulata*).	S. America.	Stout.
2 Burrowing Boas (*Eryx thebaicus*)	Gold Coast.	Ordinary size.
Ocellated Bladder-frog (*Leptodactylus ocellatus*).	Argentina.	Long, thick.

Intestinal Organisms.

Reptiles.

Viperine Snake (*Tropidonotus viperinus*).	Europe.	Amœbæ.

NOTES ON THE FOREGOING.

1. The total incidence of microbic and parasitic diseases causing death in the Gardens for 1916 is 8·5 per cent. in mammals, 6·1 per cent. in birds, and 9·4 per cent. in reptiles. If those cases which have not lived six months in the Gardens be excluded, these percentages will be greatly reduced.

2. The numbers of deaths from tuberculosis amongst the mammals and birds show a relative increase, the incidence being 1·8 per cent. in mammals and 2·8 per cent. in birds. Amongst the mammals dying from tuberculosis, 16 in all, 7 were Monkeys, and of these 5 had been pet animals; of the remaining 9 animals 4 had been pets. These figures seem to me to indicate quite plainly that pet animals should not be accepted by the Society, or only after the strictest quarantine. An Orang Utan which had been 8½ years in the Gardens had chronic tubercle of human type, which he might very well have brought with him. The most remarkable case this year was in an Ibex which died when about a fortnight old with tubercle of liver, spleen, and mesenteric glands. There is a relative increase this year in the number of deaths from tubercle amongst the birds, and in a much larger relative number were the lesions generalized, namely in 36, indicating a more severe type of the disease. The one reptile was an Alligator in which the disease was of human type, and was no doubt caused by the habit of certain visitors of spitting at the animals, to which I have often called attention in previous reports.

3. As usual I have grouped all the diseases caused by moulds under mycosis. In the mammals six of the cases were of the ordinary type, associated with abscesses; and in six, tumours (mycetomata) in various organs were present. In a sheep the growth began in the cavities of the nose and spread into the adjacent bone-spaces. There is a slight relative increase amongst the birds, but there are now less than half the number of cases there were a few years ago. In one Parrot it was caused by *Aspergillus niger*. Three of the six reptiles died with mycotic tumours in various parts.

4. The incidence of pneumonia remains about the same as last year amongst the mammals and birds. In one bird it was due to trematodes and in three reptiles to worms, otherwise it was pneumococcal. There has been a slight increase amongst the reptiles.

5. The septicæmias were due to abscesses in two cases, to extensive ulceration in two, and in one to a decomposing fœtus.

6. This rare infection of the lungs and air-sacs of a Pheasant from Mongolia has been noticed only once before in the Gardens, in a Hangnest from La Plata. The mite was a *Cytoleichus*.

7. In these cases of nematode worm infection the lesions produced were very different: in a Lynx they caused a pseudotubercle of the liver, in a Puma they caused perforation of the stomach-wall and peritonitis, and in a Toad they produced a pneumonia.

8. There has been relatively a small increase in the diseases of the respiratory organs amongst the mammals. They are, of course, largely dependent on weather, and 26 of the cases of broncho pneumonia occurred in the last two months of the year, during bad external conditions. Among the birds there has been a considerable relative decrease in the deaths from congestion of the lungs.

9. There has been a considerable increase in the number of cases of enteritis amongst the birds, but it has been of a milder type. 54 of the bird cases were hæmorrhagic; in 4 worms were the cause, and in 3 foreign bodies, and 2 were due to amœbæ; during the last three months of the year 28 Parrots have died from that specific kind of enteritis called Psittacosis. Of the cases in mammals, 3 have been hæmorrhagic, 4 associated with ulceration of the intestines, and 1 was caused by foreign bodies. The term enteritis covers all inflammatory diseases of the intestines, and as these are due to so many different causes it may be worth while to mention them. In the Gardens I have found five different varieties, which are due to the following causes: 1. Errors in feeding. 2. Foreign bodies. 3. Worms. 4. Bacteria. 5. Protozoal organisms. Of these causes the first and the fourth are the most important.

10. There has been a considerable relative decrease in the number of cases of nephritis. This word, like enteritis, covers inflammations of the kidney which are due to various causes. Nephritis can be divided, for purposes of classification, into acute and chronic; the former being due to infection, or to exposure, and the latter either following the acute disease, or being due to degenerative changes and associated with cardio-vascular changes, with old-age changes, or the artificial old-age changes induced by captivity. The absence of proper space for exercise must render animals more sensitive to temperature changes, and especially to draughts. 16 of the mammals had acute nephritis, and 18 chronic; only 1 bird had acute nephritis, all the others being chronic; in all the 5 reptiles it was chronic.

11. The three cases of cancer occurred in the liver, spleen, and adjacent glands of an old Bear, in the liver and adjacent organs and glands of a Cavy, and in the neck of a Wolf. The case of the Wolf is of interest because his father died here in 1914, and his mother in 1915, of the same disease in the same situation. A sister is alive and well.

12. A Coypu died from an angiosarcoma of the liver; it had also an adenoma of the kidneys, and is of interest as being the third case of similar tumour of the liver, and the fifth of similar tumour of the kidneys in Coypus dying in the Gardens during the last 9 years.

13. Of lymphatic variety in a Polecat. This is the second case of this rare disease which has occurred in 9 years.

14. The injury was a ruptured heart in a Flamingo, and is mentioned because it is the fifth Flamingo which has met with the same rare accident.

15. Further details of these blood parasites will be found under the section "Blood-Parasites," p. 32. Under the term malaria are grouped cases due to *Hæmoproteus danilewskyi* and to *Plasmodium præcox*.

16. These were due to a large *Saccharomyces*.

17. These cases in birds were due to the deposition of masses of crystals (of guanin, probably) in both visceral and parietal pericardium.

18. The only aneurism found this year was in a Civet, of fusiform variety.

19. This rare complication of kidney disease occurred in a Mandrill which had acute upon old nephritis.

4. On the Structure and Function of the Mouth-parts of the Palæmonid Prawns. By L. A. BORRADAILE, M.A., F.Z.S., Lecturer in Zoology in the University of Cambridge, Fellow, Dean, and Lecturer of Selwyn College.

[Received September 19, 1916 : Read February 6, 1917.]

(Text-figures 1–51.)

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I.

In the course of an investigation of the commensal prawns of the subfamily Pontoniinæ, it became necessary for me to compare their mouth-parts with those of the free-living Palæmoniinæ, in order to discover whether there existed between these groups any difference, in the organs in question, which might correspond with the difference in the diet of the animals. For the most part I have taken as representative of the Palæmoninæ the Common Prawn (*Leander serratus*), in which I have studied in some detail the structure and arrangement of the mouth-parts, and endeavoured, by the observation of living specimens, to find out how the organs in question are used. Surprisingly little trace has appeared of such structural differences between the subfamilies as I was looking for, but my observations have suggested, with regard to the morphology and functions of the parts around the mouth of Palæmonidæ, certain reflections and conclusions which form the subject of this communication.

II.

1. The morphology of the jaws of Malacostraca is still in a good deal of confusion, and there is much disagreement as to the relation of the parts of each of them to those of other crustacean limbs, and even as to the names to be applied to certain of their processes or "laciniæ"*. A great part of this difficulty arises from the fact that no theory as to the primary form of limb of which all the appendages of Crustacea are modified representatives has met with general acceptance. This thorny question is not

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* I have not, in this summary article, made any reference to the literature of the subject. The contributions of Beecher, Boas, Claus, Coutière, Hansen, Huxley, Lankester, Packard, Thiele, and others to our knowledge of homology of the limbs of Crustacea are well known to those who are interested in the subject. The reader will readily gather in what respects my views differ from or agree with those expressed by each of them, and it is needless to emphasize the fact that all present speculation must be based upon the foundation they have laid.

only raised by the jaws of Malacostraca, but receives from the study of some of them—notably from that of the maxilla—considerable elucidation. The following, briefly stated, are the considerations in regard to it which have influenced the morphological suggestions put forward in the present paper.

2. It is not to be assumed without question that a prototype can be found from which all the limbs of all Crustacea can be derived by modification. The mere fact that appendages stand in the same position on the bodies of two or more segmented animals, or are members of the same meristic series in one animal, affords no ground for the assumption that there exists a common plan which underlies the arrangement of the parts of each of them. Moreover, even when there are resemblances between them, such a conception as that of a common type of them is of no use to the zoologist unless the plan of the type does not merely exist in the imagination of the observer, but has or at some time had an objective existence as a factor in development. Resemblances between two limbs may be due either solely to extrinsic causes -that is, to influences from without the organisms, which have brought it about that different developmental processes result in similar structures in the two cases, or also to intrinsic causes—that is, to the operation of identical developmental factors. Only in the latter case has a common plan for the two limbs an objective existence. Conceivably such a plan may not be due to community of ancestry in all instances. When two appendages closely resemble one another as do, for instance, the various antenniform limbs of Arthropoda—it is possible, and sometimes probable, that there exist in the mechanism of development facilities for establishing such organs, and that these have come into play independently more than once, forming appendages upon the same plan. This principle, however, is of limited application. Even in the cases which suggest it, it can never be applied save to actual features which exist in all the limbs under comparison. To assume the existence of a plan *of which some features are not realized* in each limb is quite unjustified, except on the hypothesis of the common inheritance both of a type of limb and, in the case of serial resemblance, of community of type between the members of the series of limbs*. To look for traces of a common type in structures in which it is so little obvious as in the appendages which appear to correspond in different Crustacea would be absurd, unless there were grounds for believing that their possessors were descended from a common ancestor; and if we are also to find community of type between the several limbs of each individual crustacean, then such community must have existed among the appendages of the ancestor.

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* The resemblances here classed as due to extrinsic causes are those which are generally classed under the head of Analogy. Those which are due to common descent are instances of Homology. Those which are due to independent operations of the same developmental facilities (if such there be) form a third class not strictly the same as either Analogy or Homology.

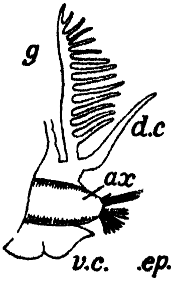
For if (as might well be, by homoeosis) it were independently established in any members of the subphylum, then the altered limbs would lose what they had in common with the corresponding limbs of other Crustacea.

3. In point of fact, however, there can be no doubt that the Crustacea are monophyletic, and it is very highly probable that their ancestor possessed a complete series of similar limbs. The widest gaps in the crustacean system are those which separate the Copepoda and the Cirripedia from the rest of the subphylum, but it is quite impossible even in these cases to entertain the suggestion of an independent origin The occurrence of the nauplius would by itself negative this. That in the common ancestor of the group all the limbs, with the possible exception of the antennules, conformed to one type may be gathered with some confidence from the conditions in Branchiopoda and Trilobita. The Branchiopoda are certainly the most primitive of existing Crustacea. They alone possess in a simple form— allowance being made for certain obvious specializations, such as the degeneration of the mouth parts all the elements of the organization of every other class of the subphylum, and their suggestive resemblances to the Annelida are the only indications of affinity with other phyla shown by any recent members of the group. These facts fairly entitle them to be regarded as indicating broadly the ancestral features of the Crustacea. It is needless to dwell upon the fact that their trunk-limbs are all of one type, and, although that type becomes unrecognizable in their maxillæ and maxillules, its presence in these limbs of other groups (Ostracoda, Malacostraca, and Copepoda) supplies the lacking evidence here. In the Trilobita, which are without doubt related to the forbears of the Branchiopoda, a single type of limb extends throughout the body, from the antennæ backwards. It is not possible to avoid attributing to the ancestor of the Crustacea that similarity of appendages which characterizes these groups. This, of course, is not to say that the limbs of the first crustacean resembled closely either those of the Trilobita or those of the Branchiopoda. The form of the primitive crustacean appendage can only be conjectured with probability after comparison of all those which may be assumed to be derived from it. But, whatever it may have been, the foregoing considerations justify the belief that it existed, and that from it can be derived all the post-antennular limbs of every member of the subphylum.

4. The primitive limb of the Crustacea must have been of the kind to which the terms "leaf-like" and "phyllopod" are applied—that is, flattened, lobed, and feebly, if at all, jointed (text-fig. 2). This is *à priori* likely in view of the structure of the parapodia of Annelida, and seems established by the way in which the phyllopod limb is distributed among the Crustacea, occurring as it does throughout the trunk of Branchiopoda (text-figs. 3–5), on the hinder and presumably less mature, segments of *Triarthrus* (text-fig. 6), in Leptostraca (on the thorax,

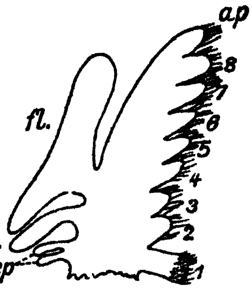
text-fig. 8), and in the hinder part of the head of all groups. Whether it was biramous, like most parapodia, the limbs of the Trilobita *, and many of those of the higher Crustacea, is another question. In the majority of biramous crustacean limbs the protopodite and endopodite form an axis to which the exopodite is appended, while the trunk-limb of the Branchiopoda is so clearly uniramous that there is discussion as to which of its

Text-figure 1.



Parapodium of *Eunice maxima*, after Ehlers.

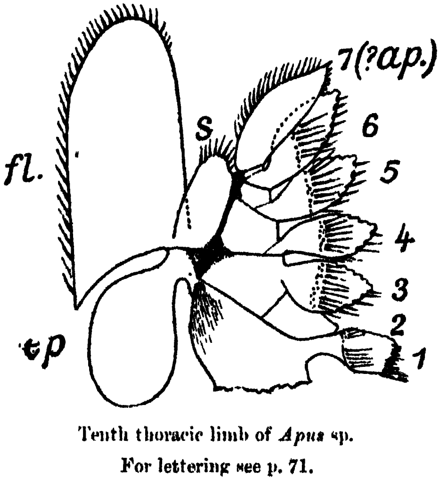
Text-figure 2.



Hypothetical limb of proto-phyllopod.

For lettering see p. 71.

Text-figure 3.



Tenth thoracic limb of *Apus* sp.

For lettering see p. 71.

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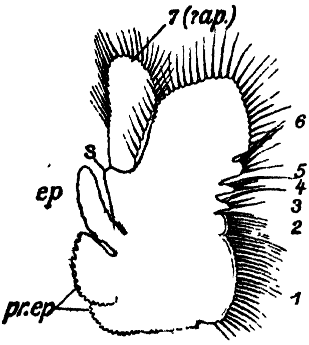
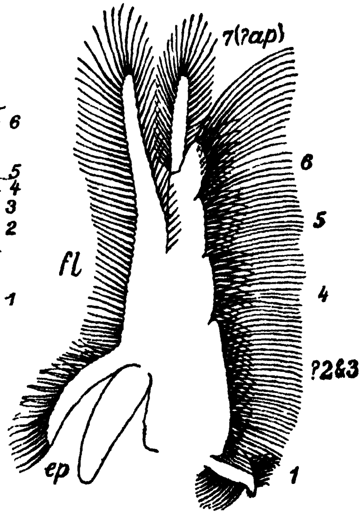
* But see footnote to p. 48.

Text-figure 4.



Thoracic limb of *Chirocephalus* sp.

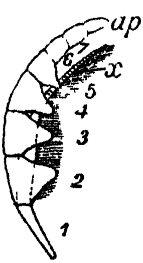
Text-figure 5.



First thoracic limb of *Limnadia lenticularis*, after Sars.

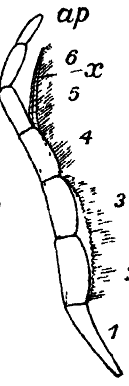
For lettering see p. 71.

Text-figure 6.



Anterior pygidial limb of *Triarthrus becki*, drawn from a model by Beecher.

Text-figure 7.

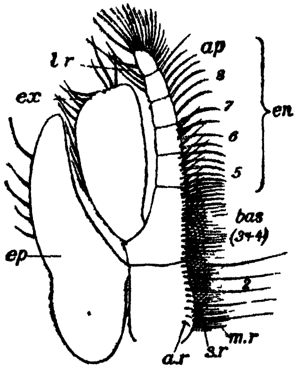


One of the anterior thoracic limbs of the same.

For lettering see p. 71.

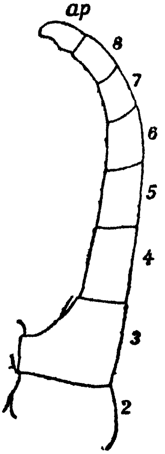
processes represents the exopodite. Probably the primitive crustacean appendage (text-fig. 2) resembled that of the Branchiopoda in being uniramous. On its outer side this limb must have

Text-figure 8.



Thoracic limb of *Nebalia* sp.

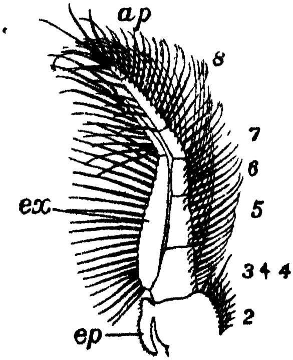
Text-figure 9.



Outline of axis of thoracic limb of old female of the same.

For lettering see p. 71

Text-figure 10.

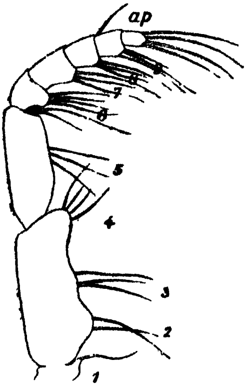


Thoracic limb of *Paranebalia longipes*, after Sars, joints added after Thiele.

For lettering see p. 71.

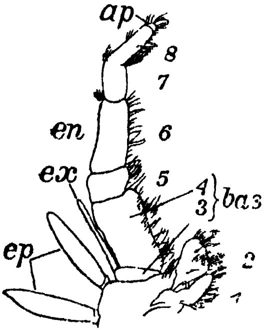
borne near its base several epipodites. There is no necessity to suppose that these were present to the full number of the gills and other epipoditic structures that may be found on a single segment in various Malacostraca *. It is highly probable that

Text-figure 11.



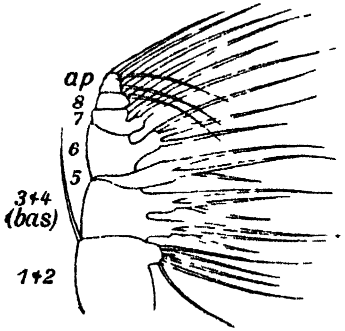
Maxilliped of *Calanus* sp.
For lettering see p. 71.

Text-figure 12.



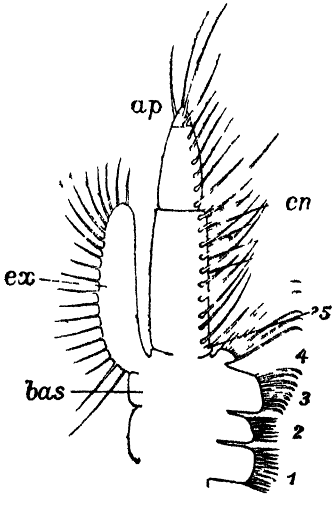
Maxilliped of *Anaspides*, after Calman.
For lettering see p. 71.

Text-figure 13.



Maxilla of *Calanus* sp.

Text figure 14.



Maxilla of *Nebalia* sp.

For lettering see p. 71.

either branching and subsequent division, or meristic repetition has taken place here. But it is not unlikely that the presence of three epipodites (the epipodite proper and two "pro-epipodites"), as, for instance, in *Chirocephalus* (text-fig. 4), is a primitive feature. Beyond the epipodite stood a longer process, the flabellum, which may have been slender, like those of Conchostraca (text-fig. 5) and the exopodite of *Paranebalia* (text-fig. 10), but is perhaps more likely to have been broad, like that of *Apus*

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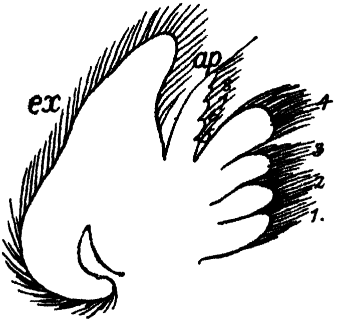
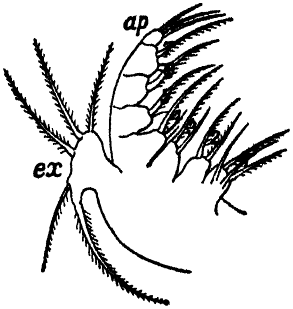
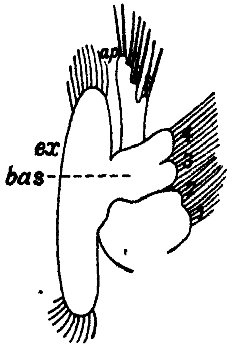
* See Ann. Mag. Nat. Hist. ser. 7, vol. xix. p. 462 (1907).

Text-figure 15.

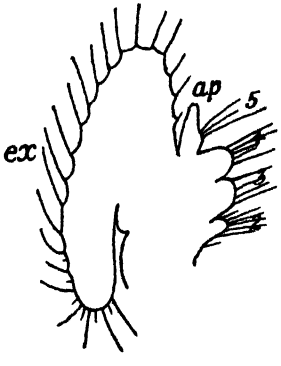


Text-figure 16.





Text-figure 17.



Text-figure 18.

Text-fig. 15. Maxilla of *Cerataspis*, after Boas.
" 16. Larval maxilla of *Penæus*, after Claus.
" 17. Maxilla of *Anisocaris*, after Ortmann.
" 18. Larval maxilla of *Palæmonetes*, after Boas.
For lettering see p. 71.

(text-fig. 3) and the exopodites of most Leptostraca (text-fig. 8) and of the decapod maxilla (text-figs. 15–18, and 47). It probably extended both distally and proximally from its attachment, like the conchostracan and notostracan flabella and the maxillary expodite of Decapoda. The axis of the limb ended in an apical lobe, and on the inner edge stood a row of endites. It does not follow, from the fact that these, with the member resembling them which probably represents the apical lobe, number six in many Branchiopoda, that the primitive limb possessed only that quota. In certain cases the series is more numerous. Thus in Anostraca it has probably seven members*, the maxillæ of certain decapod larvæ (text-figs. 16, 17) certainly possess eight, and the same limb of *Cerataspis* (text-fig. 15) bears nine. If, as seems likely, the first member is missing in the maxilla of *Calanus* (text-fig. 13), there is evidence here also that the series may consist of eight endites and an apical lobe. It may be that the ancestral crustacean possessed even more endites, but there is some reason for believing that it had eight only, since, as will be shown later, that number allows an arrangement which corresponds with the segmentation of the thoracic limb of Malacostraca, and with what was probably the primitive structure of the maxilla both in Decapoda and in Copepoda. If this view be adopted, there may be recognized in the primitive crustacean limb nine successive regions—eight represented by the endites and a ninth consisting of the apical lobe. These regions would be potential segments, since jointing would certainly take place between the endites rather than across them, as, in point of fact, it is seen to have done in *Triarthrus* (text-fig. 6), in the larval maxilla of *Penæus* (text-fig. 16), and in Notostraca (text-fig. 3). In the latter there may be found, immediately behind the attachment of each endite, a distinct articulation. In the case of the distal members of the series, the articulation extends only as far as the longitudinal sclerite by which the part of the axis that bears the subapical lobe, flabellum, and epipodite is separated from the rest. Just behind the flabellum, however, a very sharp jointing extends right across the limb, and another less marked articulation runs from the base of the epipodite to the inner margin, which it reaches just above the attachment of the blunt-ended proximal endite. Yet another articulation, starting from that just mentioned, joins the inner edge of the limb behind the base of the first of the large, pointed endites, thus cutting off a roughly triangular segment which in *Apus*, but hardly in *Lepidurus*, projects as a small lobe like an endite †.

The proximal endite—the gnathobase—of the primitive limb may be judged from the evidence afforded by the Branchiopoda and *Triarthrus* to have differed in shape from the others, been directed towards the mid-ventral line of the body, and served for the manipulation of food. Probably it had a stout, blunt end, set with rows of strong, short bristles (text-fig. 27). The remaining endites were, most likely, subsimilar to one another.

5. It is natural to attempt to derive this limb from the parapodium of an Annelid ancestor. If the limb was uniramous, we must seek for analogies among uniramous parapodia, such, for instance, as those of the Syllidæ or the Eunicidæ. In the latter family

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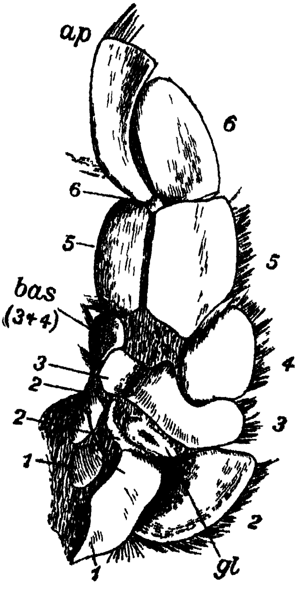
* See footnote to p. 18.

† See footnote, p. 48.

(text-fig. 1), the arrangement of the parts is strikingly suggestive of those of the phyllopod limb, the so-called "dorsal cirrus"—really the notopodium, whose small size and position upon the base of the large straight neuropodium make the parapodium uniramous—standing for the flabellum, the gill for the epipodite, and the short, broad, ventral cirrus for the gnathobase. Needless to say, no more than analogy can be claimed for this likeness. The point of origin of the Arthropoda from their worm-like ancestors is not to be settled merely by a general and hypothetical resemblance of the limbs.

Text-figure 19.



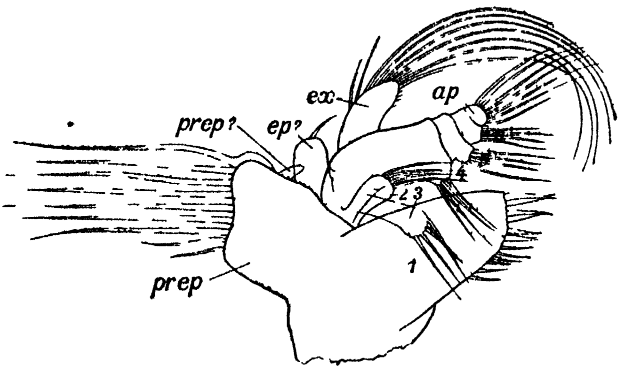
Maxilla of *Lysiosquilla maculata*.

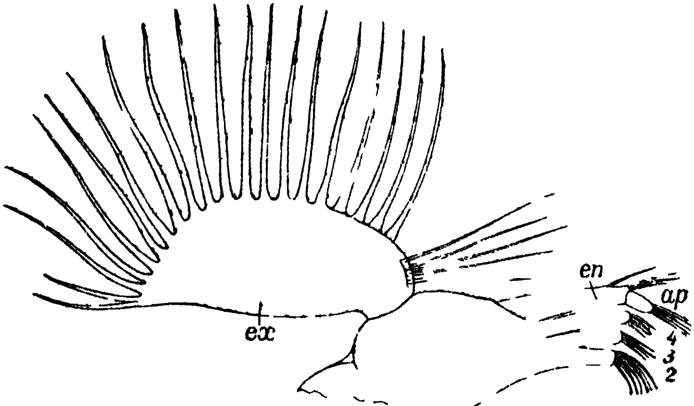
For lettering see p. 71.]

6. It has already been pointed out (p. 39) that the presence upon the hinder part of the head of Malacostraca, Ostracoda, and Copepoda of appendages not greatly modified from the assumed primitive type (text-figs. 13-21) justifies the surmise that in the original crustacean the series of similar limbs extended further forward than in Branchiopoda. Probably it resembled that of the Trilobita in including all the appendages behind the antennules, but comparison of the maxilla of the Decapoda with the pygidial limbs of *Triarthrus* suggests that there was less unlikeness between the extreme members than in that genus. Each appendage was no doubt capable of being used for swimming, for

the manipulation of food, and for respiration. In all recent Crustacea, however, the specialization of certain of the limbs for each of these functions, and for a fourth, contact with large bodies, such as prey, or the substratum, has caused them to

Text-figure 20.





Text-figure 21.

Text-fig. 20. Maxillule of Calanus sp.
„ 21. Maxillule of Cypris sp.
For lettering see p. 71.

depart in various directions from the type. Those which were specially adapted for swimming became biramous*, those for mastication developed the gnathobase with or without some of the other endites, those for respiration the epipodites, and those for contact with large objects the main axis. Generally speaking, the limbs which in the adult are adapted to other functions than swimming are in the larva (and were perhaps at one time throughout life) natatory, and retain in their later condition traces of the biramous plan, so that they may be regarded as belonging to the biramous type. In becoming biramous, the limb has lost its leaf-like character. This has in all cases befallen the antennæ and mandibles, which, precociously adapted in the Nauplius to swimming, never exhibit the primitive configuration. On the other hand, the maxillæ almost invariably retain a good deal of resemblance to the phyllopod prototype, probably because their position makes it impossible for them to be of much use either as jaws or for swimming. The trunk-limbs of Branchiopoda are phyllopod, and show in some detail the features which it is necessary to attribute to those of the ancestral crustacean *; those of the other groups are biramous †, with the exception of the thoracic appendages of the Leptostraca, which exhibit various degrees of transition from the phyllopod to the biramous condition.

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* This change must have taken place more than once. It is already established, for instance, in the antennæ and larval mandibles of various Branchiopoda which show no trace of it in their other limbs, and it is well developed upon the abdomen of the *Nebalia*, while it is still but incipient in the thorax. The Conchostraca (text-fig. 5), whose trunk-limbs are almost biramous, show how easily that condition can arise by an alteration in the proportions of the parts of the limb.

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* The lobes of the trunk-limbs of Branchiopoda (text-figs. 3-5) are exceedingly difficult to homologize. It seems, for instance, quite possible that the Anostraca have no flabellum, and that the structure known by that name which is jointed to the end of their limbs corresponds to the so-called last (sixth) "endite" of *Apus* and *Limnadia*. If so, however, an additional endite must be intercalated into the series in Anostraca or excalated from it in Notostraca, for in the former group there are six of these lobes before the terminal structure in question, but in the latter only five. The facts of meristic variation would explain this discrepancy without difficulty, but the actual solution is probably indicated by the presence in *Apus*, though barely in *Lepidurus*, of what looks like a vestigial endite, standing in the gap between the first and that which has been regarded as the second of the series. This little lobe bears no bristles, but the section of the axis opposite it is defined by lines of soft cuticle, such as those which mark out the segments of the other endites. If there be here a true endite, the series in *Apus* corresponds with that of Anostraca. *Lepidurus* must then be considered to have lost the second endite (though not its segment), and in *Limnadia* it has perhaps fused with the third. It is true that this hypothesis is open to the objection that it brings the epipodite opposite the third endite, but such a displacement presents no great difficulty in view of the vestigial nature of the supposed second segment, which does not reach the outer edge of the limb, and of the fact that the epipodite is attached not wholly to the third segment, but astride of the articulation between it and the portion of the limb proximal to it. Again, the little process known as the "subapical lobe," present in *Apus* and *Branchipus*, but barely or not at all represented in some other genera, as *Chirocephalus* and *Limnadia*, may or may not represent the true end of the axis of the limb. If it does not, then the apex must be the so-called last endite. This (if the above conjecture with regard to the flabellum of Anostraca be true) is always an organ *sui generis*, separated by a more or less distinct joint from the rest of the limb. In either case, the condition of the apical lobe in the Branchipoda is abnormal as compared with that which it shows in the larval maxilla of the Decapoda and in *Triarthrus*, which in this respect probably more nearly represent the ancestral Crustacea. To judge from the thoracic limbs of *Nebalia* (text-fig. 9), whose end-joint differs strongly from the rest and is much more sharply articulated, the appendages upon the trunk of the phyllopod ancestor of the Malacostraca must have resembled those of the Branchiopoda in respect to the apical lobe.

† The limbs of the Trilobita (text-figs. 6, 7) present an interesting problem in that, while they are undoubtedly biramous in the sense of consisting of two subequal rami upon a common stem, their "exopodites" are inserted in a different position from those of recent Crustacea or from the flabella of the Branchiopoda. The "endopodite" of the pygidial limb (in *Triarthrus*) is clearly comparable with the

7. The relation of the parts of the biramous limb to those of its leaf-like forerunner may be elucidated by a study of actual phyllopod appendages. It would seem that the flabellum is represented by the exopodite, and the main axis, ending in the apical lobe, by the protopodite and endopodite. In regard to the exopodite, the evidence of the Leptostraca, in which it is flattened and bears just the same relation to the other parts of the limb as the flabellum, is too strong to be set aside without more convincing reasons than have been adduced. Theories which disregard this consideration depend upon the precarious support afforded by a comparison of the arrangement in various cases of the endites. These structures, however, are very variable and difficult to homologize, and in particular those of the maxilla, which in adult reptant Decapoda appear to suggest that the fifth and sixth endites have become endopodite and exopodite, have in more primitive members of the same group a quite different aspect, which supports strongly the theory stated above. The larvæ of various Carides, as, for instance, that of *Palæmonetes* (text-fig. 18), show at the base of the endopodite of the maxilla, in the region of the ischipodite, a distinct fifth endite. In other cases, as in *Anisocaris* (text-fig. 17) and *Penæus* (text-fig. 16),

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axis of the phyllopod limb, and in shape more nearly resembles the larval maxilla of a Decapod than the trunk-limb of a Branchiopod. It is remarkable only for the comparatively unimportant facts that the region of the third and fourth endites, instead of forming a single joint (the basipodite), is divided by an articulation into two, each of which bears one endite, and that beyond the fourth endite the limb has but four segments, instead of the five which the maxilla of *Cerataspis* (text-fig. 15) indicates as the full complement of the corresponding region of the decapod limb. It does not seem impossible that an additional segment may eventually be discovered at the end of this appendage. The conditions are none too clear in Beecher's model. The "exopodite," however, stands upon the segment of the second endite, not upon that of the third and fourth. Probably this indicates that the structure here called the exopodite is not homologous with that to which the same name is applied in recent Crustacea, but is a modified epipodite. In that connection it is interesting to note that Beecher attributes to it a respiratory function. If the foregoing theory be correct, the thoracic limbs of Trilobita present a very remarkable analogy to those of Decapoda, consisting as they do of a subcylindrical, seven-jointed axis with a complex respiratory structure borne on the outside near the base. Unlike the podobranchs of the Decapoda, however, the epipodite of the Trilobita "contrives a double debt to pay" as gill and "exopodite.'

The foregoing interpretation of the limb of *Triarthrus* receives very interesting support from the arrangement of the parts of the mesosomatic appendages of *Limulus*. Here the axis bears on its outer side three broad exites, separated from it and from one another by sutures to which correspond notches on the edge of the limb. (The first exite of the gill-bearing limbs is, upon its anterior face, divided into about a dozen strips by less-marked sutures, of which only two remain in the genital operculum.) That part of the axis which bears the first and second exites is unjointed, but the third is attached to a well-marked segment, and beyond this two free joints form the apex of the limb. The first and second exites are crossed obliquely upon their hinder face by the gill-lamellæ. It is pretty clear that they are epipodites, and a comparison at once suggests itself between them and the very differently shaped "exopodite" which bears gill-lamellæ in *Triarthrus*. The third exite in *Limulus*, sharply distinct from the second, is no doubt the exopodite.

The supposed biramous mouth-parts of Insecta are not so in reality, and I take this opportunity of retracting the view I have expressed on that point in my 'Manual of Zoology' (London, 1912). The lacinia and galea are, I now believe, the third and fourth endites, and the palp is the endopodite.

this is succeeded by a sixth and a seventh, while in *Cerataspis* (text-fig. 15) the endopodite bears four endites, making eight altogether, besides the apical lobe in the position of the dactylopodite. In the last two cases it is clear that the endopodite represents the whole distal part of the limb, and not, as has been supposed, the fifth or sixth endite only.

For a detailed comparison of the jointed stem formed by the protopodite and endopodite of the biramous limb with the endite-bearing axis of the phyllopod appendage, it is necessary to find some fixed point of correspondence between members of the two series. It would be natural to look for this at the base of the limb, but the development of *Penæus* and other Decapoda, during which the basal joint of the appendages of the thorax recedes into the side of the body, is a warning against the use of such a method. On the other hand, the differences in the total number of endites in different limbs makes it useless to start a comparison from the distal end. The epipodites vary in number, and their homologies are doubtful, so that their points of attachment afford no reliable clue. There remains the flabellum-exopodite. It is unfortunate that the uncertainty which exists in regard to the homologies of the endites of Branchiopoda makes even the seat of the flabellum a doubtful point in that group, but, as will be seen, what can be stated on this point is not without its uses in confirming the evidence of other classes. In the Anostraca (text-fig. 4) the flabellum is probably absent. In Conchostraca (text-fig. 5) it stands opposite the junction of the second and third endites of a series of six, but, quite possibly, these two members represent the third and fourth of the full series, the second, which is present in the Anostraca, being in Notostraca vestigial and in Conchostraca either lost or fused with the third to form a single elongate lobe. In Notostraca (text fig. 3), where the whole axis of the limb is more or less strongly segmented, the flabellum stands on the segment of what may be the third or the fourth endite. In the maxilla of the Malacostraca (text-figs. 14 18, and 47) the situation is clear. Here the exopodite arises opposite the third and fourth endites, upon a region of the limb which may be undelimited, as in most Decapoda, but which is often marked off more or less completely to form a segment, as in Leptostraca (text-fig. 14), Mysidacea, Cumacea, Euphausiacea, and the decapod larva *Anisocaris* (text-fig. 17). Where there is no exopodite, as in Isopoda, Amphipoda, and Stomatopoda* (text-fig. 19), a segment with two endites is found in the same position on the maxilla as on that of the orders in which the limb bears an exopodite. The maxilla of *Calanus* (text-fig. 13) agrees remarkably in structure with that of Malacostraca. Though it has no

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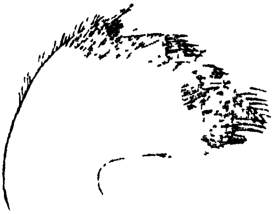
* In the maxilla of the Stomatopoda. the basipodite is represented upon the outer side of the limb by a single sclerite, but the segment of the third endite is differentiated from that of the fourth by the possession of a sclerite of its own upon its hinder face. The structure of this rather puzzling limb is elucidated in text-fig. 19. It is interesting to note that the maxillary gland opens on the second joint, like the antennary gland of Mysidacea and Amphipoda.

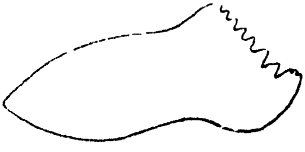
exopodite, there may be found in its proximal half a double segment bearing two endites. At first sight, the endites upon this segment appear to be the second and third, but the length of the segment which precedes it, and the position of the endite upon the latter at its distal end, suggest at once that that is also a double segment, that here, as in Carides, the first endite has been lost, and that the second double segment therefore bears the third and fourth endites and is the basipodite. This impression is strengthened by the fact that beyond the segment with two endites there are five simple segments, as there are beyond the endites which represent the basipodite of *Ceratuspis* (text-fig. 15), which, since in that respect it agrees with the thoracic limbs of Malacostraca, may be taken as indicating the original number of segments in this region in the malacostracan maxilla. In the maxillule of *Calanus* (text-fig. 20) the first endite is carried upon a fairly distinct segment, but the second, third, and fourth lie upon a region which is undivided save by an incomplete constriction, which marks off the distal portion of it, where the fourth endite and the exopodite are borne. The maxilliped of *Calanus* (text-fig. 11) has a very short basal segment bearing the small first endite, a long second segment bearing the second, third, and fourth endites, and six distal segments, which is one more than might be expected. Meristic rearrangement has probably been at work in this portion of the limb*. The maxillule of *Cypris* (text-fig. 21), which curiously simulates the maxilla of Carides, seems, like the latter appendage, to have lost the first endite. If that be the case, the exopodite here stands opposite the third and fourth endites. The thoracic limbs of *Nebalia* (text-figs. 8, 9), though they present no endites,

Text-figure 22.



Maxillule of *Lepas* sp.

Text figure 23.



Mandible of *Lepidurus* sp.

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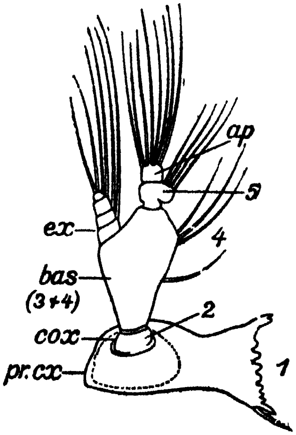
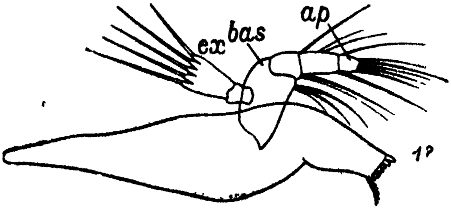
* An increase beyond the normal of the number of joints in a crustacean limb may take place in three ways: (1) by the annulation of the unsegmented apex of either branch of the limb to form a "flagellum," as in antennæ, thoracic exopodites, and pleopods of Malacostraca, etc. Three faint annulations upon the apical segment of the maxilla of *Calanus* are probably of this nature; (2) by subdivision of a segment, as in the carpopodite of various Carides; (3) by resegmentation of a limb or of part of it, as probably in the maxilliped of *Calanus*.

are instructive in regard to the segmentation of the phyllopod limb. Here the number of the segments which are formed in the endopodite varies with the limb and with the age and sex of the individual. Nearly always the four distal segments can be made out, and often a fifth is to be found proximal to them, leaving a long basipodite, which is always clearly marked off from the coxopodite. Across the basipodite, distal to the exopodite, there occasionally appears an additional joint, the faintest of the series, indicating the double nature of the segment *.

Text-figure 24.





Text-figure 25.

Text-fig. 24. Mandible of *Calanus* sp.
„ 25. Mandible of *Cypris* sp.
For lettering see p. 71.

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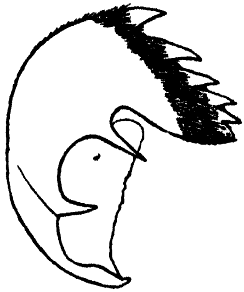
* It is perfectly true that most of these segments are without muscles, but from that it does not follow that their evidence may be disregarded. Probably they are vestigial, having lost their endites, and not, as where the limb becomes subcylindrical, acquired a value of their own. The division of the basipodite probably occurs also in *Anaspides* (text-fig. 12), where, in the anterior thoracic limbs, the endopodite appears to contain six joints, but is flexed between the third and fourth of these, not between the second and third as in the Eucarida. It seems likely that the first

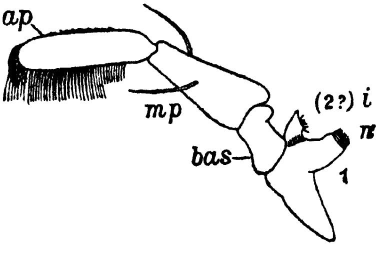
It appears, then, that the flabellum-expodite, which in the unjointed limb arises opposite the third and fourth endites, is, when the appendage becomes jointed, generally borne by a double segment, representing those of both the lobes in question, but if, as occasionally happens, the two components of this segment become distinct, the exopodite may be found either upon the proximal of them (*Nebalia* etc.) or upon the distal (maxillule of *Calanus*, Notostraca?). Thus in the axis of the phyllopod limb the region of the third and fourth endites corresponds to the basipodite of the biramous limb, that of the first two endites to the rest of the protopodite, and all that part which lies beyond the fourth endite to the endopodite. The doubleness of the basipodite makes necessary certain terms for the distinction of its parts. Its two components may be known as the *probasipodite* and *metabasipodite*, and when either of these alone acts as the basipodite by bearing the exopodite, it is a *hemibasipodite*. In contradistinction to this the complete double joint may be called the *symbasipodite*.

Text-figure 26.



Mandible of *Lepas* sp.

Text-figure 27.



Mandible of *Nebalia* sp.
For lettering see p. 71.

In the proximal part of the branchiopod limb, the most persistent of the epipodites stands opposite the second endite. The segment to which these structures belong is the coxopodite. If other epipodites (pro-epipodites) be present, they stand in the region of the gnathobase. This region is the so-called "precoxa," or "pleuropodite," which may or may not have originally existed as a free joint in every biramous limb, but has now nearly always

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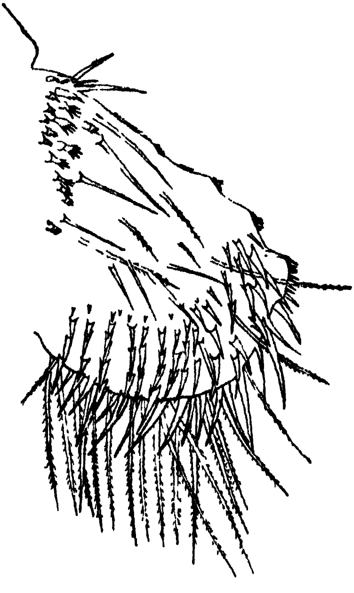
segment after that which bears the exopodite is here not the ischiopodite, but the second division of the basipodite, or, as it may be called, the *metabasipodite*. If this be so, the question arises whether the basipodite be not divided in the Pericarida, whose thoracic endopodites also are flexed between the apparent third and fourth joints. But in that case their apical joint must represent the fused propodite and dactylopodite. With Calman, I am unable to regard the so-called "stylopodite" as more than an enlarged, terminal spine. If it be one of the primary members of the axis of the limb, it must represent the apical lobe, and the total number of joints in the axis becomes ten, as in the maxilliped of *Calanus*.

disappeared, either by fusion with the trunk or with the second joint, or perhaps sometimes by excalation.

The fifth endite and those distal to it belong to that part of the limb which stands beyond the attachment of the flabellum, and represent the endopodite of the biramous limb. The maxillæ of *Cerataspis* and larval Natantia (text-figs. 15–18) seem to show that each of these endites is borne upon a portion of the limb which represents a single joint of the biramous appendage, and that the apical lobe is an unsegmented distal region of varying extent, corresponding to the dactylopodite and any adjacent segment or segments not represented by an endite.

Text-figure 28.



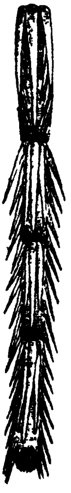
Gnathobase of thoracic limb of *Lepidurus* sp.

It is fair to assume that all these relations existed in the primitive crustacean appendage, and that the latter gave rise to the biramous limbs by a transformation in which the axis of the limb became jointed in the way indicated, the endites in great part or altogether disappeared, and the flabellum approximated in shape to the distal part of the axis and came to stand side by side with it at the end of the third (or, if the precoxa were not separate, the second) joint of the limb.

8. With the original phyllopod limb, thus reconstructed, the jaws of Malacostraca may be compared as follows:—In the

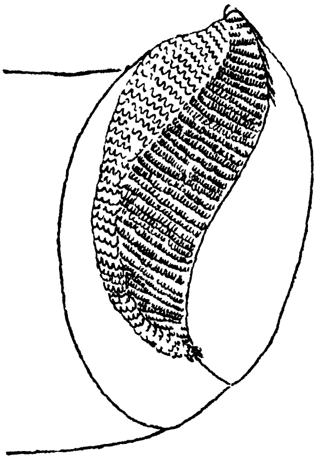
mandible, homologues must be found for the molar process, the incisor process, and the palp. The molar process pretty clearly represents the mandible of the Branchiopoda, and through that the gnathobase of the phyllopod limb. The grinding-surface of the mandible of *Chirocephalus* (text-fig. 30) is covered by two comma-shaped patches of fine ridges, each ridge consisting of a row of tubercles, which perhaps represent the rows of stout bristles upon the end of the gnathobases of the trunk-limbs of Notostraca (text-fig. 28). In places the ridges bear some hairs. The commas are reversed, so as to fit against one another, and one patch is narrower then the other and composed of coarser ridges. In view of its structure, position, and function, there can be little doubt that this organ is a specialized gnathobase.

Text-figure 29.



End view of maxillule of *Lepas* sp.

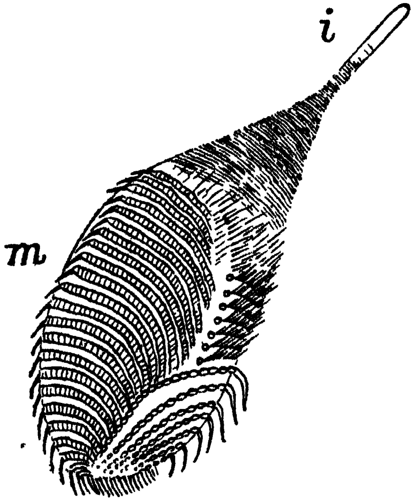
Text-figure 30.



End view of mandible of *Chirocephalus* sp.

Two sets of ridges, very similar to those on the mandible of *Chirocephalus*, may be recognized at the end of the molar process in *Nebalia* (text-fig. 31), though here one is of less extent than the other, and seems largely to have been replaced by rows of delicate hairs. Fine ridges, as may be seen in the figures given by various authors, exist also upon the molar processes of various Malacostraca (*Anaspides*, *Gammarus*, etc.). In the Decapoda a crescentic or comma-shaped set of serrated ridges is often present (text-figs. 32, 43), with or without patches of hairs and granules, though they tend to disappear, and the molar surface is often broken up into a small number of large lobes. The ridges vary greatly in width, degree of salience, and serration, but are often much like those of *Nebalia* (text-figs. 38–43). Clearly, we have here the mandible of *Chirocephalus* in process of further evolution. The homology of the incisor process is more puzzling. No trace of it can be found in the Entomostraca. In *Lepidurus* (text-fig. 33) the end of the mandible, instead of being oval as in *Chirocephalus*, is elongate, tapering to one end, and slightly curved. It is crossed by deep ridges, few in number, and marked each by a few coarse tubercles. The narrow end stands away from the rest, bears three or four teeth instead of the ridges on the wider part, and somewhat suggests an incipient incisor process, but this is at the hinder end of the organ, whereas the incisor process of Malacostraca is anterior. It seems likely that the biting-surface of the mandible of Notostraca represents one of the two sets of ridges found in the same position in *Chirocephalus*. In *Calanus* (text-fig. 35) the condition is not dissimilar. The biting surface is narrow, elongate, tapering towards the ends, especially towards the hinder end, and crossed by coarse ridges, variously tuberculate. At the anterior end stands a structure which at first sight a little recalls the incisor process, but in an end view of the mandible this is seen to be only the first ridge, removed a little from the rest and connected with them by a flange. The mandible of *Cypris* (text-fig. 34) is of the same type, but the anterior ridge is less outstanding and not

Text-figure 31.

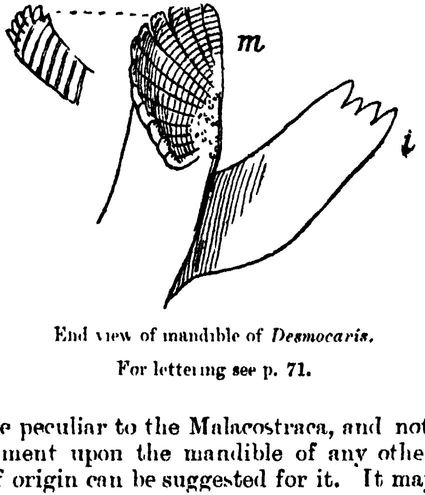


End view of mandible of *Nebalia* sp.

For lettering see p. 71.

flanged to the next, the ridges are more regular, the valleys between them bear spines, and at the hinder end there is not, as in *Calanus*, a single long, fringed spine, but a pair. Probably the biting-surfaces of the mandibles of *Calanus* and *Cypris* are homologous with one another and with that of *Lepidurus*. The mandible of *Lepas* (text-figs. 26, 36) is a very different structure, thin, with a sharp, toothed edge, and in side view very similar to the incisor processes of certain Decapoda. It is crossed near the base by an articulation, and it seems possible that its toothed edge represents, not the gnathobase, but the second endite. On the other hand, the maxillule of the barnacle (text-figs. 22, 29), which appears to be built on the same plan, is of a fair width at the end, and crossed by short ridges, each bearing a row of five spines, so that this limb forms a sort of transition from the ridged condition of *Cypris* to that of *Lepas*. Unless the mandible of the barnacles be homologous with the incisor process, the latter is a structure peculiar to the Malacostraca, and not to be found even in rudiment upon the mandible of any other crustacean. Two modes of origin can be suggested for it. It may be regarded either as an outgrowth from the gnathobase or as representing the second endite. On the whole, the latter is the more plausible view. From its first appearance in *Nebalia* (text-figs. 27, 31) this process has a knife-edge, quite unlike the ridged surface of the molar process and its homologues, although it often comes to bear a row of teeth. As has been shown, there is no trace in phylogeny of its origin from the proximal part of the limb, and, though in ontogeny (as, for instance, in that of *Penæus* or the Stomatopoda) it and the molar process may originate from the same simple precursor, this is no more than the differentiation, in the course of development, of the rudiment of the appendage, and happens also in the case of the palp. If this view be correct,

Text-figure 32.

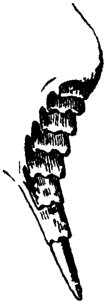


End view of mandible of *Desmocaris*.

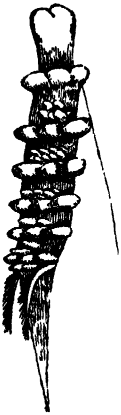
For lettering see p. 71.

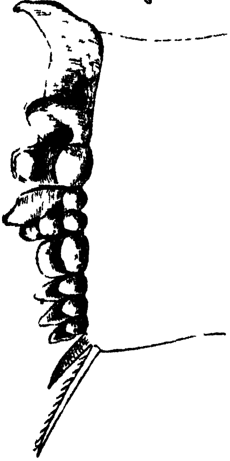
the basal joint of the mandible of Malacostraca corresponds to the fused precoxa and coxopodite. Those of Branchiopoda represent the precoxa only, the rest of the limb having disappeared. The basal segment of Copepoda, again, corresponds to no more than the precoxa, the coxopodite being represented

Text-figure 33.

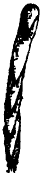


Text figure 34.





Text-figure 35.



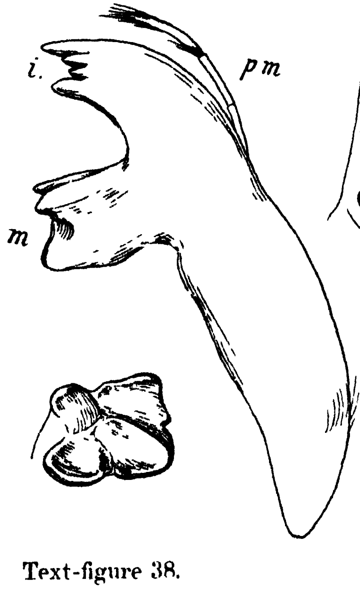
Text-figure 36.

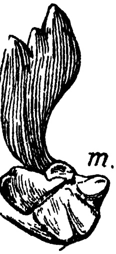
Text-fig. 33. End view of mandible of *Lepidurus* sp.
„ 34. End view of mandible of *Cypris* sp.
„ 35. End view of mandible of *Calanus* sp.
„ 36. End view of mandible of *Lepas* sp.

by the little segment between that which bears the biting-edge and that upon which stand the exopodite and endopodite in *Calanus* (text-fig. 24). In Ostracoda (text-fig. 25), it would seem, the coxopodite must either have been excalated altogether or have fused with one of the adjoining segments. The mandibular palp represents the remainder of the axis of the limb. Its first segment is undoubtedly the basipodite, though there is nothing to show whether it is a complete symbasipodite. Often a joint divides the remainder into two parts, but these cannot be regarded as corresponding with any of the normal segments of the endopodite *.

The mandible of the Crustacea is an exceedingly complicated, varied, and interesting organ, presenting many problems and worthy of a great deal more attention than it has received.

Text-figure 37. Text-figure 39.





Text-figure 38.

Text-fig. 37. Left mandible of *Leander serratus*.
„ 38. End view of molar process of the same limb.
„ 39. End view of right mandible of *Leander serratus*.
For lettering see p. 71.

The laciniæ of the malacostracan maxillule (text-fig. 46) represent the first and third endites. This is suggested, though hardly proved, by the condition of the limb in *Nebalia*. Hansen has shown that in various other genera the laciniæ belong to the first

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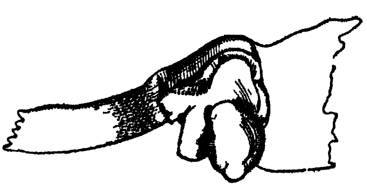
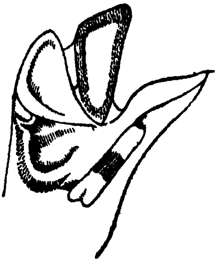
* G. W. Smith (Q. J. M. S. liii., iii. p. 506, 1909) describes a mandibular palp in *Paranaspides* which would be quite unique among such structures in the Malacostraca, having four joints and an exopodite. I am unable to confirm this. All the specimens in the British Museum have three joints and no trace of exopodite.

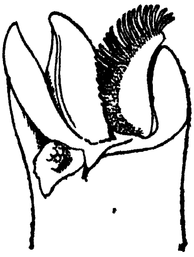
and third segments. In many Decapoda, as in *Leander* (text-fig. 46) the same fact is clear upon careful examination. I shall call the processes in question the *inner and outer laciniæ*. The outwardly-directed lobe which is often present upon the first segment has been regarded by various authors as the exopodite, and the conclusion drawn that the part of the limb proximal to the basipodite is lacking. It is hard to see upon what evidence this view can be based. The exite is much more easily interpreted as a proepipodite. It is represented in *Leander* by a hump upon the base of the first endite.

Text-figure 40.

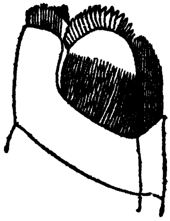


Text-figure 41.





Text-figure 42.



Text-figure 43.

Text-fig. 40. End view of left mandible of *Conchodytes tridacnæ*.
„ 41. End view of left molar process of *Periclimenes spiniferus*.
„ 42. Oblique view of end of right molar process of the same species.
„ 43. Same view of right molar process of *Saron marmoratus*.

The two cleft lobes usually known as the "laciniæ" of the maxilla (text-figs. 14–17) are each equivalent not, as has sometimes been supposed, to one of the elementary segments of the limb, but to two, and thus they together represent the first four endites of the primitive limb. This interpretation is strongly suggested by such appendages as the maxillæ of larval Penæides (text-fig. 16) and especially by that of *Cerataspis* (text-fig. 15), and is not contradicted by the fact that articulations are often not developed between the first and second or between the third and fourth segments—as, for instance, in *Anisocaris* (text-fig. 17), which is an instructive case of this condition. The first endite is frequently absent, whether or not its segment be present as a separate entity. In the Peracarida, the number of endites is generally reduced in this way to three (or fewer, if another of them be absent), though the Mysidacea at first appear to form an exception. In *Mysis*, however, closer examination reveals a condition which may be described as follows. The edge of the second segment proximal to its endite is rounded, meets the base of the endite in a notch, and bears a row of bristles which is continued from the notch across the origin of the endite. The notch forms an outline which simulates the cleft lobe formed in Eucarida by the first two endites. If this suggestion be correct, the Mysidacea, liike other Peracarida, must be regarded as having lost the first endite of the maxilla. In Leptostraca (text-fig. 14), Anaspidacea, Stomatopoda (text-fig. 19), and typical members of the Eucarida (text-figs. 15–17), it is present. The degree to which the first and second, and again the second and third, endites are associated to form cleft lobes varies, and is highest in some Decapoda. I shall allude to these double structures—the so-called "laciniæ" of the maxilla—as the *first and second lobes*. The first comprises the endites of the precoxa and coxopodite, the second those of the basipodite. The fifth endite is often represented in the adult by a slight swelling at the base of the endopodite. The exopodite (scaphognathite) is a little-modified flabellum, and a small rounded lobe proximal to it in Eucarida perhaps represents the epipodite.

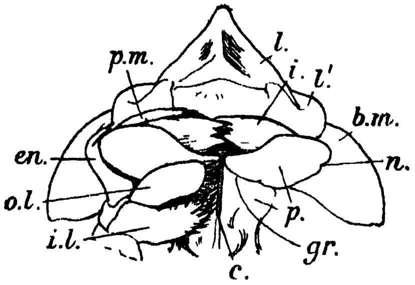
In the first maxilliped of Decapoda (text-fig. 48) the third and second endites are distinct. The latter is often marked by a slight notch, which, however, is not likely to indicate the presence of the first endite, the precoxa being probably fused with the body in the thoracic segments of this group. In *Anaspides*, as is shown by the history of the development of the gill-rudiments (text-fig. 12), the first and second endites are both present, and the basal joint carries also two epipodites, from which it would appear that the precoxa in this genus is fused with the coxopodite. The Peracarida probably agree with *Anaspides* in this respect, as they have two epipodites (oostegite and gill) upon the basal joints of the thoracic limbs. Endites may be present upon the endopodite of the maxilliped in the Peracarida, as in *Mysis* (and perhaps also in *Gammarus*, but in the latter there is some doubt about the identity of the apparent ischiopodite which bears the endite in question: see footnote to p. 53). Knobs bearing bristles which sometimes appear upon the coxopodites of the second and third maxilliped of prawns (text-figs. 49, 50) may represent the second endite, and a similar knob in the sternal region at the base of the second maxilliped may be a vestige of the gnathobase.

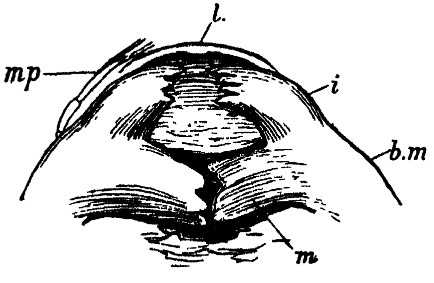
III.

1. The mandible of the Palæmonidæ (text-fig. 37) is deeply cleft into two diverging processes, both directed obliquely towards the median plane of the body. One of these—the incisor process —is a thin structure, more or less ribbon-like in the Pontoniinæ and *Desmocaris* (text-figs. 32, 40), but shorter and broader in *Leander serratus* (text-fig. 37). It trends, at its base, downwards, but curves inwards and at the same time twists its outer edge forwards, so that, while at its base it is nearly vertical, with its width transverse to the body, at its free end it is nearly horizontal, with its width longitudinal to the body. The other—the molar process -is stout and subrectangular in section, and slants dorsally, to end somewhat obliquely truncated on the median plane. In the Palæmoninæ a delicate palp, usually three-jointed, stands on the anterior side of the limb, at the base of and just dorsal to the incisor process, along whose outer edge it curves towards the middle line of the body. The only Pontoniinæ which possess a mandibular palp are *Urocaridella* and *Palæmonella*. In these it is two-jointed.

The incisor process of Pontoniinæ usually ends in three teeth, the midmost of which is shorter than the others, but there are sometimes more. Thus in *Coralliocaris japonica* there are four on one mandible and five on the other, and in *Conchodytes tridacnæ* (text-fig. 40) there are on one side five, nearly equal, and on the other six. In *Leander serratus* (text-fig. 45) there are two large teeth, with on the right mandible one, and on the left two, smaller intermediate teeth. In *Desmocaris* (text fig. 32) there are four teeth on the right and five on the left mandible, those at the outer ends of the row being rather larger than the others. In each case the arrangement is not such that the teeth of the two sides can closely interlock. The molar process of most Palæmonidæ (text-figs. 38-42) ends in a roughly square concave surface, around which is an incomplete wall composed of from four to six projecting lobes. Some of these have crescentic or horseshoe-shaped rims, with their open sides towards the middle of the process. Others are completely rimmed, but raised more on the outer side than on the inner. In *Leander serratus* (text-figs. 38, 39) there are four sharply distinct lobes. The lobes differ a good deal in shape, and there is only a general correspondence between those of the mandibles of the two sides. So far as this correspondence goes, it is not the mirror-likeness usually found in paired structures, but the two arrangements are reversed, so that there is a rough sort of interlocking. In *L. serratus* the lobes are only roughened in places. In the Pontoniinæ one lobe, and part of the rest of the surface, bears a fur of bristles or is roughened by tubercles. This, I believe, is the last remains of the clothing of bristles found on the end of the molar processes of other Carides, such as the Alpheidæ. In the primitive Palæmonid *Desmocaris* (text-fig. 32) the process ends in a semicircular surface, which bears a comma-shaped patch of serrated ridges. Sollaud, who called attention to the difference between the molar surfaces of *Desmocaris* and those of other Palæmonidæ *, pointed out that these ridges also occur in the Acanthephyridæ, and regarded them as a primitive feature. In this he is probably right, since, as I have shown, a similar arrangement is found in *Nebalia* and certain Branchiopoda. In *Amphibetæus* and some Hippolytidæ (text-fig. 43) part of the surface is covered with such ridges and part with bristles, and lobes of various shapes are appearing. We have here probably a transition from the ridged condition to that which is found, for instance, in Pontoniinæ.

Text-figure 44.





Text-figure 45.

Text-fig. 44. Ventral view of mouth-parts of *Leander serratus* after removal of maxillipeds, maxillæ, and left maxillule.

Text-fig. 45.—The same after removal of maxillules and paragnatha.

For lettering see p. 71.

2. The mandibles lie (text-figs. 44, 45) in a chamber enclosed between the lips, the hood-like labrum standing in front of them, and the large bilobed metastoma behind, while the swollen bases of the mandibles themselves close in the chamber at the sides.

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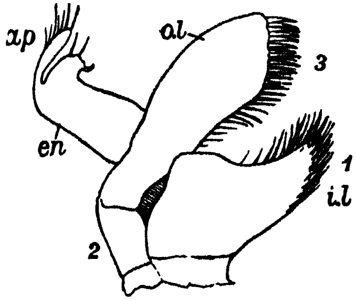
* C. R. Ac. Sci. clii. p. 913 (1911).

There are two openings to the lip-chamber—a narrow median slit between the lobes (paragnatha) of the metastoma and a wider transverse gap between the metastoma and the labrum. The incisor processes close the transverse opening, meeting in the middle line. The molar processes meet deeper in the chamber, just under the opening of the gullet.

3. In the maxillule (text-fig. 46), the inner lacinia, which is usually the narrower of the two, curves towards the outer and is provided with relatively feeble bristles. The outer lacinia has very stout, yellow bristles and is probably the only structure, other than the mandible, which is capable of tearing the food. The endopodite is bifid at the tip. the proximal branch, which possibly represents an endite, being curved in a short spiral, the distal branch nearly straight. The maxillules stand close against the paragnatha (text-fig. 44), the laciniæ of each opposed to those of the other across the median line, but not quite meeting them.

Text-figure 46.



Maxillule of *Leander serratus*.

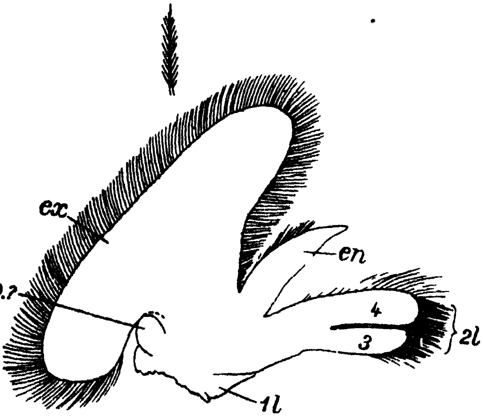
For lettering see p. 71.

The inner laciniæ are just behind the cleft of the metastoma, the outer stand beside the cleft. The endopodite is directed outwards and hooks its curved process around the outer edge of the paragnathum, which has a notch to receive it. Probably this gives a purchase for the action of the limb.

4. In the maxilla (text-fig. 47), the first double lobe has disappeared and is represented only by a slight swelling of the edge of the limb. The second lobe is of good length, but tends to become simple in the Pontoniinæ. In this respect it is very variable, the maxillæ of the two sides sometimes differing in an individual. From the frequent occurrence of reduction in the lobes of this limb in the Carides, it would seem that they are structures of no great physiological importance. The endopodite is of simple shape, tapering distally, and the exopodite (scaphognathite) varies in shape and width with the gill-chamber, and

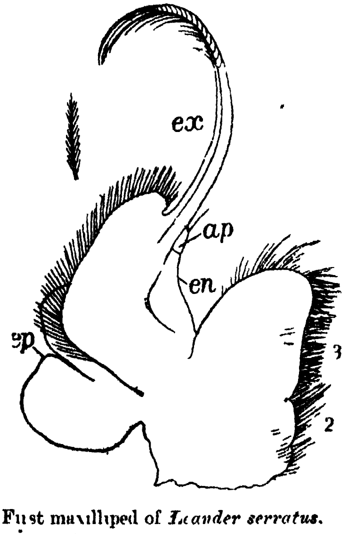
thus with the habit of body. The long bristles which fringe the scaphognathite are feathered, which probably makes the organ more efficient in sweeping the gill-chamber.

Text-figure 47.



Maxilla of *Leander serratus*.
For lettering see p. 71.

Text-figure 48.



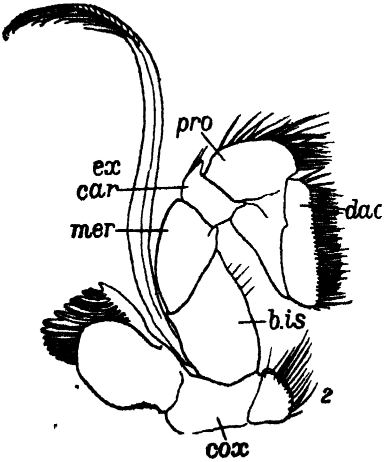
First maxilliped of *Leander serratus*.
For lettering see p. 71.

5. In the first maxilliped (text-fig. 48), two endites—the second and third—are nearly always recognizable, and usually

separated by a very distinct notch. The notch in the proximal endite, though less distinct, can often be made out. The endopodite is simple with a stout bristle near the top, and often indications of a joint a little further down. At the tip of the exopodite a few small joints may be present and at its base on the outer side is a fringed lobe (lobe *a* of Boas) which varies in width with the body and has perhaps some function in regard to the current which the scaphognathite sets up in the gill-chamber. Its bristles are feathered like those of the scaphognathite. The epipodite varies much in size, and its outer border is usually notched.

6. In the second maxilliped (text-fig. 49), the main axis consists of six joints, the basipodite and ischiopodite being fused.

Text-figure 49.

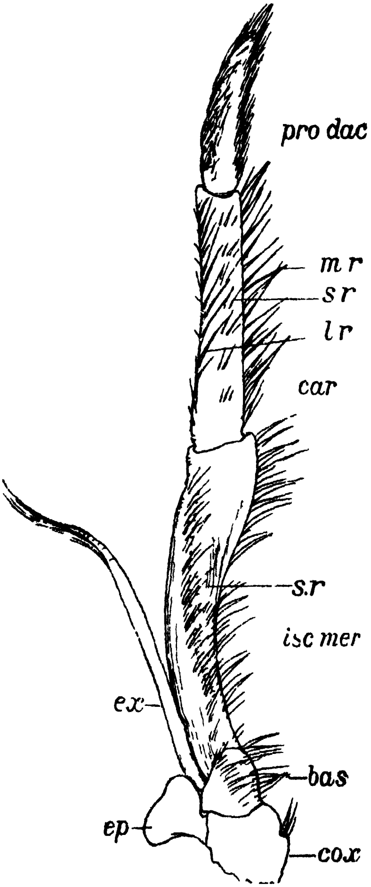


Second maxilliped of *Leander serratus*.
For lettering see p. 71.

The last two joints are bent strongly backwards on the inner side of the limb, so as to lie parallel with the ischiopodite, and, owing to the backward (morphologically forward) growth of a process of the propodite on the outer (morphologically inner) side of the dactylopodite, the latter comes to lie along the median side of the former, instead of at its apex. Thus these two joints are compacted into a firm plate, which presents a long median margin, fringed with bristles, against its fellow of the opposite side. This is, of course, the typical caridean condition of the limb. The exopodite is obscurely annulate in the greater part of its length, and bears at the end a comparatively small number of true joints. The coxopodite carries on the outer side a simple epipodite (mastigobranch), at the base of which may be a gill (*Leander*, *Urocaridella*) or the vestige of one. On the median side of the coxopodite is a knob, which bears bristles, and may represent an endite. A sternal swelling which is sometimes present at the base of the coxopodite may represent a precoxal endite.

7. The main axis of the third maxilliped (text-fig. 50) consists of four or five joints (five in *Leander* and in *Urocaridella*, four in

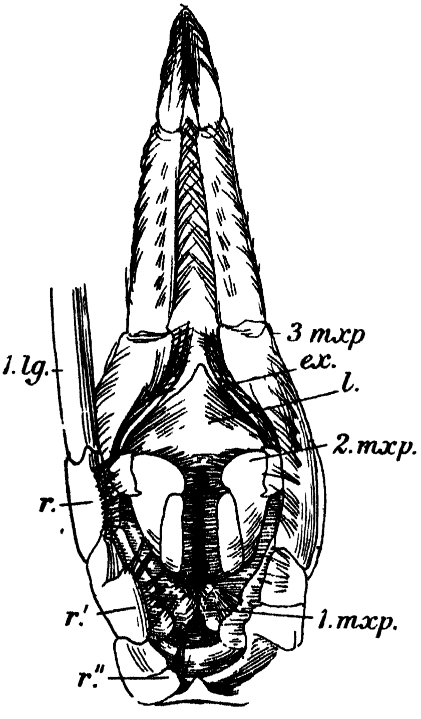
Text-figure 50.



Third maxilliped of *Leander serratus*.
For lettering see p. 71.

most Pontoniinæ), the propodite being always fused with the dactylopodite and the ischiopodite with the meropodite, and often also the basipodite with the ischiomeropodite, in which case the junction is generally marked by a notch. The coxopodite bears on the outside a small rounded epipodite, and often on the inside a bristly knob which is perhaps an endite. The exopodite is obscurely annulate, and at its end there are usually a few longer segments which are sometimes true joints, but in other cases appear to be marked merely by a change in the width of the organ and the attachment of bristles. The ischiomeropodite is almost always more or less curved, with the concave side towards the middle line of the body. It is ribbon-like and shows in the Pontoniinæ a tendency to widen. The curving of this joint brings the last two joints near to those of the fellow limb, so that, while the ischiomeropodites lie at the sides of the mouth with a wide gap between them in which the second maxillipeds are exposed, the distal parts of the limbs lie side by side in front of the mouth-region. A further complexity in the arrangement of the parts of the limb is brought about by the fact that the ischiomeropodites are twisted, so that the flat surface of the appendage, which in its distal part is in a horizontal plane, is in the proximal part in a plane between the horizontal and the

Text-figure 51.



Ventral view of mouth-region of *Leander serratus*, all mouth-parts being in place.

vertical. This arrangement, combined with the presence of a fringe of bristles along the inner edge of the limb, has the effect of forming a kind of basket below the mouth-region, walled in at the sides by the ischiomeropodites and by the bristles which project downwards and inwards from their edges. In *Leander* * there are bristles borne in a diagonal row along the ventral surface of the ischiomeropodite, and also upon ridges of the coxopodite, basipodite, and ischiopodite of the first leg (text-fig. 51), which complete the basket behind and below, but these are less well developed or absent in Pontoniinæ. In front of the mouth, the distal parts of the third maxillipeds, with their bristles, afford a surface, horizontally placed below the antennal region while the appendages are outstretched, which by bending can be brought ventrally under the mouth so as to complete its enclosure anteriorly. The last joint often possesses along its inner side a thick brush composed of tufts of hairs more close-set than the bristles of the rest of the limb. This arrangement, which is particularly well developed in *Leander*, has probably some special function, but I have not been able to discover what that may be.

IV.

1. It is not an easy matter to induce *Leander* to feed at a given moment, and still less so to observe what it is doing while it feeds. The animal will not take food if it is not hungry, if it is languid owing to lack of aeration of the water, or if it is suffering from shock, though sometimes it will feed surprisingly soon after violent operations, such as the removal of limbs. I have tried to observe the action of its jaws by means of a mirror, but without much success. The best method is to fasten the prawn upon its back in a shallow vessel of sea water by means of plasticine. It will often feed quite freely in this position, and its jaws can easily be reached with a needle. When it is feeding, small particles of food may be seized by the chelipeds of either pair, and by them conveyed to the mouth, where they are generally received by the second maxillipeds, though sometimes they appear to be placed directly in charge of more dorsally placed structures, probably the maxillules. A large morsel occasionally appears to be steadied by the legs of the second pair, while those of the first tear off fragments and carry them to the jaws, but it is more often placed as a whole within the grasp of the second maxillipeds, which hold it in place while pieces are torn off it by deeper-lying organs, probably in the main by the incisor processes. In handling bulky masses of food, the chelipeds are assisted by the third maxillipeds, which bend back their last two joints for this purpose. The third

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* In this genus, in which the bristles of the third maxilliped are best developed, there may be made out three bands along the limb—an inner, middle, and outer, perhaps corresponding to the marginal, submarginal, and lateral of the four series found by Claus in *Nebalia* (text-fig. 8, p. 42). Each band consists of a succession of little transverse rows. Towards the ends of the appendage the bands converge and become merged.

maxillipeds are also capable by the same action of scooping up food and unaided conveying it to the second maxillipeds, between which they sometimes thrust it with their tips. During these processes the basket which has been mentioned seems to serve the purpose of keeping the food under control till it has been seized by the second maxillipeds. These are very important organs, and play an indispensable part in passing food to the mandibles. The animal can still feed if the legs and third maxillipeds have been removed, but if all the other organs be left and the second maxillipeds cut away it is apparently incapable of taking food. The second maxillipeds have three principal movements. In one, the broad flaps in which they end open downwards like a pair of doors, and with their stout fringes gather up the food; in another they rotate in the horizontal plane to and from the middle line of the body and thus narrow or widen the gap between them; in the third the bent distal part of the limbs tends to straighten so as to brush forward any object which lies between them. Frequently these movements are combined. Once the food is past the portals formed by the second maxillipeds its course is hard to trace, but the following seems to be its fate. If it be small in quantity and finely divided, or very soft, it is abandoned to the action of the maxillules, by whose strong, fringed laciniæ it is swept forwards and probably caused to enter the mouth through the slit between the paragnatha. The laciniæ can be moved separately, and the difference between them, in shape and in the kind of bristles they bear, probably corresponds to some difference in function. If the food be bulky or tough, the second maxillipeds assist the maxillules in brushing it forwards towards the incisor processes. The action of these latter is not so much a cutting as a process of tucking the food into the lip-chamber by first backing outwards and then moving inwards and rotating upwards. No doubt, during this the food generally undergoes some tearing, and when the mass of it is large, pieces have to be torn from it before they can be swallowed. The palp does not appear to take any mechanical part in the process of feeding. If it has a sensory function this is probably not of great importance, for the organ is present and absent in closely related genera in many cases among Carides. Finally, to enter the gullet, the food must pass between the molar processes and doubtless be pounded by them as it goes. Their concave ends are usually found to be clogged with a pasty matter. They must do their work very quickly, for the movement of the mandibles, as judged by that of the incisor processes, ceases very soon after the food leaves the latter. How swallowing takes place is not clear. Parker and Mocquard suggest that the food of Decapod crustaceans is caused to pass up the gullet by suction from the crop (stomach), but, as I have shown elsewhere *, the case of the land hermit-crabs of the genus *Cœnobita* throws doubt upon this explanation. It may be that the constrictor muscles of the œsophagus conduct the process.

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* Gardiner's 'Fauna of the Maldives,' vol. i. p. 79 (1901).

2. The first maxillipeds and the maxillæ probably take no very prominent part in manipulating the food. The feeble lobes of the maxillæ are in incessant movement to and from the middle line as they are carried inwards and outwards by the action of the scaphognathite. It seems not unlikely that their sole function is to regulate the motions of the latter. The large lacinia of the first maxilliped is a rather weak structure, with slender silky bristles, and is not strongly moved during feeding. Probably, by covering the lobes of the maxilla, it prevents them from being clogged by the food.

The part played by the paragnatha seems to be a passive one.

The labrum undergoes active movements, whose function is probably to aid in keeping the food under the action of the incisor processes.

3. The exopodites of the maxillipeds are in constant rapid motion, setting up by their activity a strong current forwards from the mouth. No doubt, this assists in carrying away the exhausted water from the gill-chambers and the excreta of the green glands poured out at the base of the antennæ. But it has also a significance in the feeding process. From time to time particles are rejected by the second maxillipeds, which kick them violently forwards, the distal parts of the third maxillipeds at the same time straightening so as to admit them to the outgoing stream, by which they are swept away.

Explanation of Lettering of the Text-figures.

1-8,	endites or the primary segments which correspond to them.
9,	additional segment in the maxilliped of *Calanus*.
1 *l.*, 2 *l.*,	first and second lobes of maxilla of Decapoda.
1 *lg.*,	first leg of *Leander*.
1 *mxp.*, 2 *mxp.*, 3 *mxp.*,	first, second, and third maxillipeds of *Leander*.
ap.,	apical lobe.
a.r.,	third or additional row of setæ on thoracic limb of *Nebalia*
ax.,	axis of parapodium.
bas.,	basipodite.
b.is.,	basi-ischiopodite.
b.m.,	base of mandible.
car.,	carpopodite.
cox.,	coxopodite.
dac.,	dactylopodite.
d.c.,	dorsal cirrus.
en.,	endopodite.
ep.,	epipodite.
ex.,	exopodite.
fl.,	flabellum.
g.,	gill of polychæte worm.
gl.,	papilla for opening of maxillary gland of Stomatopoda.
gr.,	groove across paragnathum of *Leander*.
i.,	incisor process of mandible.
i.l.,	inner lacinia of maxillule of Malacostraca.
isc.mer.,	ischio-meropodite.
l.,	labrum.
l.',	side lobe of labrum.
l.r.,	lateral row of setæ.
m.,	molar process of mandible.
m.r.,	marginal row of setæ.
mer.,	meropodite.
n.,	notch on paragnathum to receive endopodite of maxillule.
o.l.,	outer lacinia of maxillule of Malacostraca.
p.,	paragnathum.
p.m.,	palp of mandible.
pr.cx.	precoxa.
pr.ep.,	proepipodite.
pro.,	propodite.
pro.dac.,	pro-dactylopodite.
r., *r.'*, *r.''*,	ridges of segments of first leg of *Leander*.
s. r.,	second side row of setæ.
s.,	subapical lobe.
v.c.,	ventral cirrus.
x.,	so-called "exopodite" of *Triarthrus*.

5. On the Scolex in the Cestode Genus *Duthiersia*, and on the Species of that Genus. By Frank E. Beddard, M.A., D.Sc., F.R.S., F.Z.S.

[Received December 15, 1916: Read February 6, 1917.]

(Text-figures 1-5.)

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D. expansa Perrier	80

The genus *Duthiersia* is fairly well known to us from the investigations of authors whose several contributions are quoted later*, but there still remain a few points to which attention has not yet been directed, or concerning which there is up to the present some difference of opinion.

Some little time since I had the opportunity of examining living examples of the genus from the Nilotic Monitor, which enabled me to ascertain a structural feature which has escaped the attention of my predecessors - very probably because their investigations were made upon preserved material only. The scolices of several examples were in active movement, and from the apex of the scolex was seen to protrude a finger like process which explored the surroundings. A more careful study of these living worms showed that the apex of the scolex is occupied by a circular pit, quite small like that of many species of *Ichthyotænia*, which is apparently eversible. This pit lies between the upper extremities of the dorsal and ventral bothria, on a patch of integument which is not invaded by the bothria. The area in question is more extensive than the pit which occupies its centre. Transverse sections confirmed the existence of this structure, which has not yet been described in the genus *Duthiersia*. The pit is so small that it only appeared in two sections of one series which I prepared, and only in five of another (thinner) series. And as these are naturally the very first sections of the series and very small in area, the apical pit might be easily missed, and possibly has been.

The two series of sections referred to were transverse. I have also found the apical pit in horizontal sections through the scolex. In all of these it appears as a mere pit; certain special structures (text-fig. 1, *s*) were to be observed in the shape of delicate filaments arising from the margin of the pit, possibly of a sensory nature. As to the protrusion of the entire apex of the papilla, I believe it to consist of the tissues surrounding the pit as it was too large to be a mere eversion of that orifice. But possibly the pit was also everted, a fact of which I am not able to speak with certainty. The apical pit appears to me to be of a sensory nature, and thus perhaps does not bear any relation to the rostellum of other Cestodes. Related genera belonging to the same division of the Cestodes (*i.e.* Pseudophyllidea) throw no light upon this question. It is true that an apical depression has been described in other genera; but where this has been carefully investigated it would appear to be produced simply by an apical fusion—or nearly complete fusion—of the lateral bothria. Thus, in *Bothriomonus**, the presence of a dividing septum shows that the apical vertical slit is merely the abbreviated remains of the two bothria. Were the septum absent the homology of the depression in question might be more doubtful; I therefore believe this apical sensory (?) organ to be new to the Pseudophyllidea.

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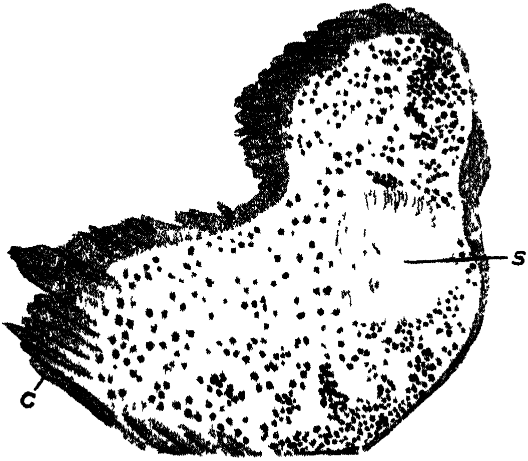
* Page 75, footnotes.

Text-figure 1.



A transverse section through the apex of the scolex of *Duthiersia fimbriata*

c, cuticle; *s*, apical sense-organ.

While I found this structure in examples of *Duthiersia* from *Monitor niloticus*, I examined other specimens of *Duthiersia* in vain.

Two series of transverse sections of the scolex of specimens from *Monitor bengalensis* showed absolutely no trace of the organ. As these were much larger scolices, the probability of my having failed to recognise the organ is thereby reduced. I have in fact little doubt that the apical pit is in those specimens quite undeveloped. A comparison in other ways between the specimens from the two species of Monitors showed plainly that we have here to deal with two undoubtedly distinct species of *Duthiersia*.

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* Cholodkovsky, Annuaire Mus. Zool. de l'Acad. Imp. Sci. Petrograd, xix. 1914, p. 520, figs. 6, 7.

This is not a novel conclusion; but it is not accepted by the majority of recent writers. Perrier[*], the original describer of the genus, found differences in examples from different species of *Monitor* and recognised two species, viz. *Duthiersia expansa* from Eastern species of *Monitor*, and *D. elegans* from African. Perrier was perfectly right, and the majority of his successors are quite wrong. The confusion of two distinct species is connected with various assertions with regard to the form of the bothria in this genus. It will be necessary to clear up this confusion. In *D. expansa* the form of the scolex is more spear-shaped than in the other species, as is plainly shown in Perrier's figures. The bothrium on each side is closed posteriorly and opens again by a minute pore closely adpressed to the commencing strobila, thus producing a tube-shaped bothrium open widely in front and by but a narrow orifice posteriorly; this funnel-like arrangement has been justly compared by many to the tube-like bothria of *Bothridium* (*Solenophorus*). According to Perrier the same orifice exists posteriorly in *D. elegans*, but at some distance laterally from the fusion of the bothria with the strobila. Monticelli and Crety[†], who examined only examples of *Duthiersia* from an Indian Monitor, confirmed the existence of the posterior pore in that worm; and, inferring its existence also in examples from *Monitor niloticus* from Perrier's statements, united both these worms into one species under the name of *Duthiersia fimbriata*; this name was given by Diesing[‡] to what he regarded as a species of *Solenophorus*, though tabulated as "species inquirenda." Diesing made his observations upon Perrier's "species" *D. elegans*. Just previously to the memoir of Monticelli and Crety, Lühe[§] took the opposite view and denied the posterior orifice of the bothrium, but agreed with the first mentioned authors in regarding the Cestodes from all species of *Monitor* as belonging to one species only, namely (of course) *D. fimbriata*. This view is accepted by Braun[‖] in Bronn's 'Thierreich,' who, in defining the genus *Duthiersia*, described the hinder region of the bothrium as "*nicht* perforirt," the italics being his own. It is true that in earlier numbers of the same volume Braun accepted Perrier's statements and even used his figures, but later altered his opinion by reason of Lühe's observations. Still later Shipley[¶] re-asserted the existence of a posterior opening of the bothria in specimens from *Monitor salvator* and *M. bengalensis*, as did Southwell[**] "In *Varanus* spp." The latter regards as synonyms both of Perrier's species. Klaptocz[††], however, in 1906 again definitely denied the existence of the posterior orifice in the bothria of *Duthiersia* from

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[*] Arch. de Zool. Expér. ii. 1873, p. 349.

[†] Mem. R. Acc. Sci. Torino, (2) xli. 1891, p. 381.

[‡] Sitzungsb. Wien. Ak. xiii. 1854, p. 589.

[§] Verb. Deutsch. Zool. Ges. 1899. p. 48.

[‖] Klassen u Ordn. des Thierreichs, Vermes, Bd. iv. Abth. 1 B. p. 1689.

[¶] Spolia Zeyl. i. 1903, p. 47.

[**] Rec. Indian Mus. ix. pt. v. 1913, p. 281.

[††] Sitzungsb. Wien. Ak. cxv. 1906, p. 133.

Monitor niloticus. The latest statement known to me is that of Cholodkovsky [*], who has defined *Duthiersia* by (*inter alia*) the fact that the "Bothridia have the appearance of a funnel with blind narrow ends formed behind." This definition presumably implies the existence of only one species of the genus.

The above brief résume shows that, while Perrier examined examples of *Duthiersia* from both the Nilotic and the Indian species of Monitors and asserted the existence of the posterior orifice of the funnel formed by the partial coalescence of the two lips of the bothrium in both of these, subsequent observers based their results upon the personal examination of one only of the two alleged species; and also shows that there is a consensus of opinion that no posterior orifice exists in examples from *Monitor niloticus*, while it is asserted to exist in examples from Indian Monitors. These observers finally appear, on the whole, to have concluded that their own observations, though made upon one set of individuals only (whether from Africa or India), applied to the others examined by their fellow-workers, and that the genus *Duthiersia* was definitely to be characterised by the possession or non-possession of these orifices according to each observer's own discovery of fact. I have made myself an examination, as already stated, of examples of *Duthiersia* from both African and Indian species of *Monitor*, and I cannot see why the obvious differences pointed out by Perrier have not been universally accepted. To these I have some fresh observations to add which, as I think, entirely justify the position taken by Perrier.

Perrier's figures show the great difference in the general form of the scolex in the two species, which is, moreover, much larger in *D. expansa* than in *D. fimbriata* (as we must, of course, call Perrier's *D. elegans*). I have already described the apical pit in *D. fimbriata*, which is not to be found in *D. expansa*, and I agree with other observers that the posterior aperture of the bothria does not exist in *D. fimbriata*. I have examined several series of sections both transverse and longitudinal, and can find no trace of this orifice. In *D. expansa*, on the other hand, it is exceedingly obvious though very minute. It lies closely adpressed to the commencing strobila to which the posterior end of the folds forming the bothrium are attached, instead of, as in *D. fimbriata*, turning upwards to be attached at a point much higher up and within the shelter of the lateral folds forming the bothrium. At the point of opening of the orifice the fused bothrial folds project laterally as a papilla upon the side of the strobila; but the actual orifice is not upon the apex of this papilla, but upon its inner side. There are other differences between the scolices of these two species of *Duthiersia*. In *D. expansa*, in tracing a series of sections from the strobila region forwards, the axis of the scolex is more sharply defined than in the other species. This is seen in transverse sections to be due to the fact that the flaps of tissue which form the walls of the bothria do not unite at their attachment to the axis, but leave a space between their inner terminations. In *D. fimbriata*, on the other hand, the two walls of the bothrium practically meet at their insertion (text-fig. 2, *e*). Thus, in both transverse and horizontal sections the axis assumes

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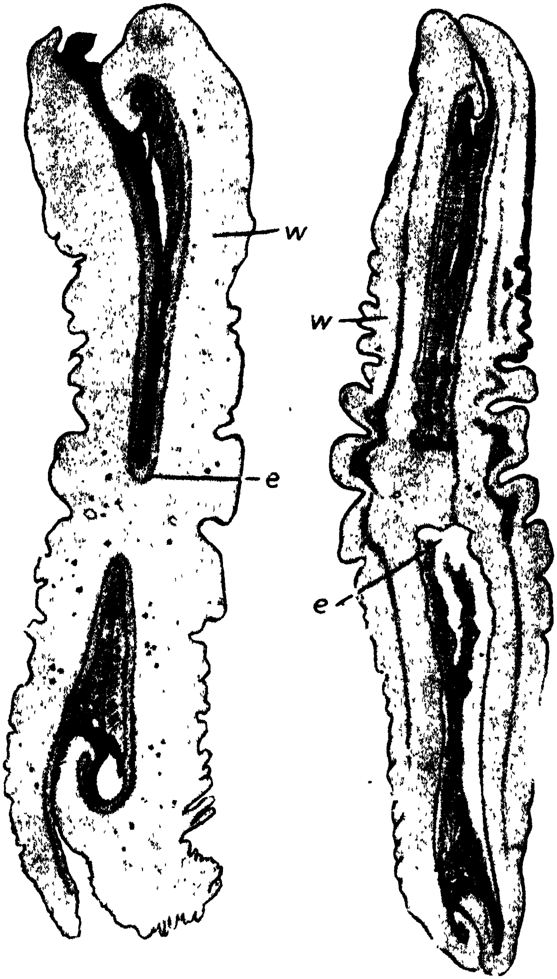
[*] Trav. Soc. Imp. Nat. Petrograd, xlv. 1914, p. 62.

Text-figure 2.

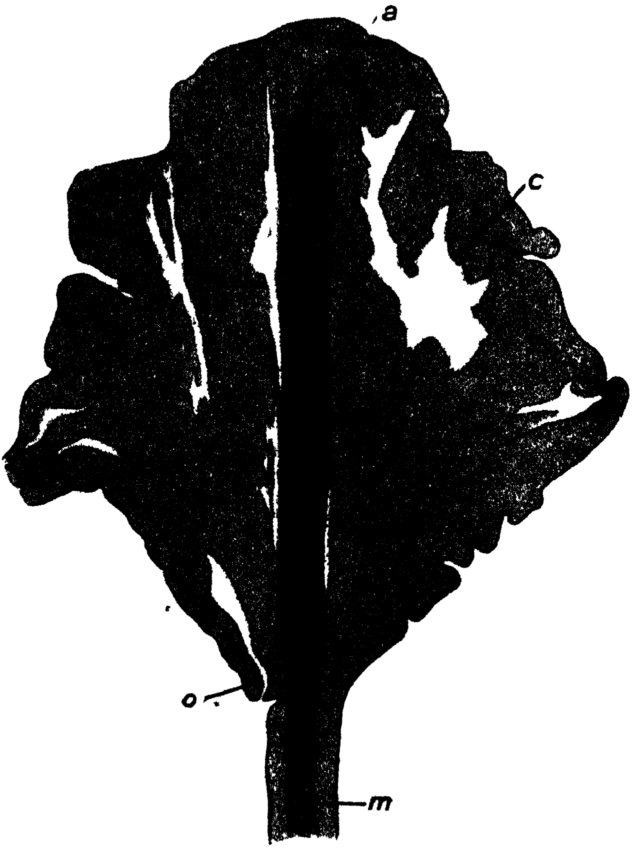


Transverse sections through scolex of (left-hand figure) *Duthiersia fimbriata* and (right-hand figure) *D. expansa*.

w, walls of bothria; *e*, junction of these with the axis of the scolex.

a greater distinctness in *D. expansa.* This is also due to the fact that in the last-mentioned species the axis of the scolex is formed from the medulla only (text-fig. 3. *a*), while in *D. fimbriata* the axis is apparently formed from both medulla and cortical layer. The point of difference is further emphasised by the more modified

Text figure 3.

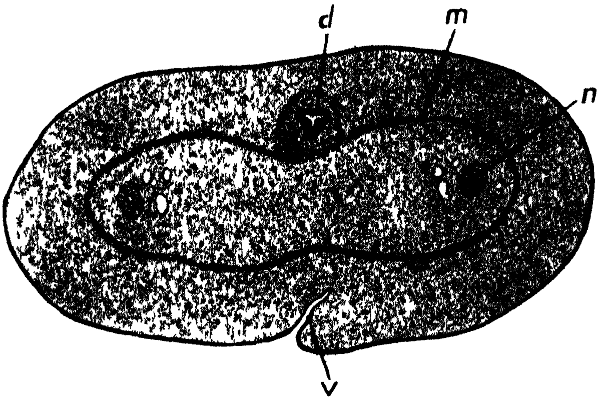


Longitudinal section through scolex of *Duthiersia expansa.*

a, axis of scolex continuous with medulla only of strobila region (*m*); *c*, cavity of bothrial groove displayed here and there; *o* posterior orifice of this cavity.

structure of the axis in *D. expansa*, where it presents the appearance of a more clearly defined network, the spaces being largely quadrilateral in outline. There is not this plain histological differentiation in *D. fimbriata*. Finally, in transverse sections through the bothrial canal up to its point of opening on to the side of the strobila, the same restriction of the bothrium to the cortical layer is to be seen very plainly; this is due to the fact that here the medulla is marked off from the cortex by a thick layer of longitudinal muscles which is itself sharply marked off both internally and externally. The tube of the bothrium traverses the cortical layer (text-fig. 4, *d*), only pushing back but not in any way taking up or invading these longitudinal muscles.

Text-figure 4.



Transverse section through posterior extremity of scolex of *Duthiersia expansa*.

d and *v*, dorsal and ventral bothria forming a narrow canal in the cortical layer, the external orifice of *v* is shown, *m*, longitudinal muscular layer dividing the cortex from the medulla, *n*, nerve-cord

Another difference between the scolices of the two species affects the water vascular system. In both the scolex is permeated by a network of these tubes which is very obvious in sections both transverse and longitudinal. I am not able to give a detailed account of the course of these vessels in the scolex, but it is quite clear that the number of tubes is much greater in the smaller species *D. fimbriata*, and that they are here of a smaller size than in the larger species *D. expansa*. We may now summarise the characters of the two species as follows -

Genus Duthiersia.

(1) D. fimbriata Diesing.

Solenophorus fimbriatus Diesing, SB. Ak. Wien, 1854, p. 589.
Duthiersia elegans Perrier, Arch. Zool. Exp. 1873, p. 360.

Scolex smaller; bothria opening by continuous antero-lateral

groove only; apical pit at extremity of scolex; water-vascular system of scolex an abundant network of small tubes.
Hab. *Monitor niloticus.*

(2) D. EXPANSA Perrier.

Duthiersia expansa Perrier, Arch. Zool. Exp. 1873, p. 359.

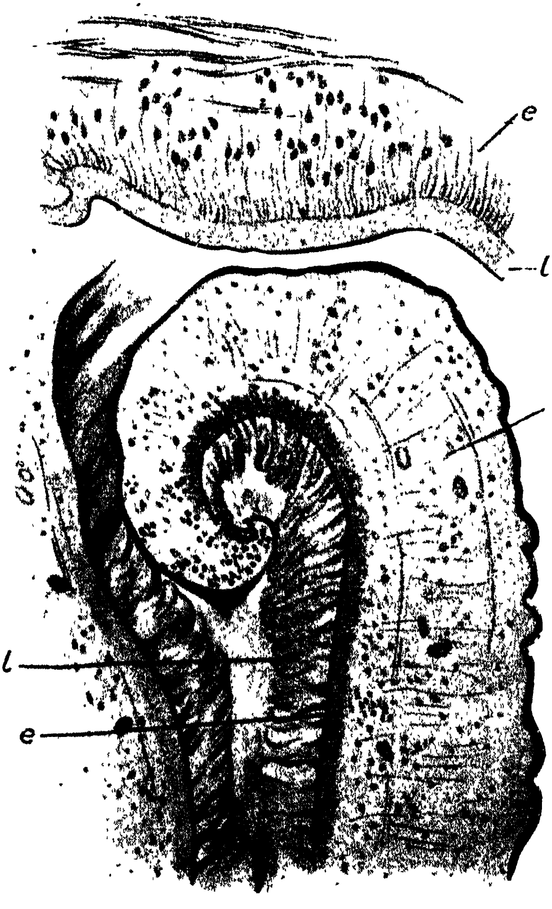
Scolex larger; bothria opening by continuous antero-lateral groove and by separate posteriorly situated pore, being thus funnel-shaped; apical pit not present; water-vascular system of scolex a less abundant network of larger tubes.
Hab. *Monitor bengalensis* and other Indian forms.

It is quite possible that were these two species found in quite different hosts (*i. e.* of different genera or families) they would be placed in separate genera. The differences of the scolex are obviously large and important as these differences go among the Pseudophyllidea. I do not, however, attempt this separation.

In conclusion I desire to draw attention to a few minutiæ in the structure of the scolex of *Duthiersia* which have not been dwelt upon by those who have already studied the structure of this genus. The strobila near to the scolex is somewhat hour-glass-shaped in section, having a dorsal and ventral depression, and thus a bulging at the two sides; this is more marked in *D. fimbriata* than in the larger species. The medulla is separated from the cortical layer by a sharply marked band of longitudinal muscles which become frayed out and thus end—as a distinct and circumscribed layer at the junction with the scolex. This layer is the same in both species. A transverse layer lying within this is to be seen in longitudinal section, but does not form a continuous coating of muscular fibre: there is simply a slender bundle of fibres at the posterior end of each segment. This layer escaped my attention in *D. expansa*, where it cannot at any rate be so obvious as in the other *Duthiersia*. This state of affairs contrasts with what obtains in *Solenophorus*, believed to be closely allied to *Duthiersia*. In the former the longitudinal layer is very much thicker and with more scattered and at the same time larger fibres, and the extent of the medulla is reduced. In transverse sections the strobila of *Solenophorus* contrasts with that of *Duthiersia* by its stouter form and oval to circular outline. This thickening of the muscular layer in *Solenophorus* is, no doubt, connected with the strong muscular supply of the walls of the bothrial tubes in this genus. But in *Duthiersia*, in transverse section, a thinnish layer of fibres is seen to extend along the projecting walls of the bothria and represents the constricting muscles seen in *Solenophorus*, though diminished in importance. Within the bothrial tubes of *Solenophorus* the hypodermic cells (subcuticular layer) are covered by a structureless stained (by reagents) and slightly opaque cuticle, outside of which is a clearer but still rather granular yellowish cuticle of chitinous appearance, of which the outermost layer is stained by reagents. In

Duthiersia the layer which is thrown off most externally by the outermost layer in the bothrial groove is quite different. It is much deeper and greatly stained by reagents. It presents (text-fig. 5) the appearance of closely approximated plates, thinner towards

Text-figure 5.



Upper figure a section through a portion of the wall of the bothrial tube of *Bothridium* (*Solenophorus*) *megacephala*.

Lower figure a similar section of *Duthiersia fimbriata*.

l, membrane immediately lining bothrial groove and secreted by (*e*) epithelial lining: between the two lies another membrane, shown as a darker line. The difference of the outermost of the two membranes in *Duthiersia* and *Bothridium* is clearly shown.

the outside but reinforced by thicker bars. When the walls of the bothrium are closed upon each other there is absolute contact between the cuticular layers of the two sides. The appearance is totally different from what is to be seen in *Solenophorus*, and thus presents a striking difference between the two genera. It should be added that in *Duthiersia*, as in *Solenophorus*, a second layer lies within the outer cuticular layer just described which is precisely like that of *Solenophorus*.

6.—1. The Coleoptera of the Family Cissidæ found in Britain, with Descriptions of two new Species.—2. A new Species of the Coleopteran genus *Cryptorhynchus* Illiger. By C. J. C. Pool, Assistant Curator Caird Insect House *.

[Received February 6, 1917 Read February 20, 1917.]

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Introduction.

It is well known that since at least the time of that eminent French entomologist the Abbe Latreille (1806), the Order Coleoptera has been divided into major groups superior to families, which have been based principally on affinities in the form and character of the antennæ, or on the number of tarsal joints.

These groups constituted, as they have been, differently by different authorities and known by different names, present anomalies difficult to reconcile or explain.

The family Cissidæ Mellié (1848), which forms the subject of these notes, is in its morphology one of the most anomalous of these constituents.

It was included by the British authority Marsham (1802) in the genus *Ptinus* L., and by Stephens (1839) in the family Bostrichidæ Leach, and close to *Anobium* F.

Thus the family maintained its position in the works of subsequent British authorities among the Teredilia or Serricornia, of which such genera formed part.

In the latest general European list (Heyden, Reitter, and Weise, 1906), the Cissidæ have been placed after the Mycetophagidæ among the Clavicornia, and as that arrangement has been followed by the most recent list of the British Coleoptera (Newbery and Sharp, 1915), I propose to adopt it here as well as the specific nomenclature of the family there used.

The Cissidæ are fungivorous, and may be found in various kinds of *Boleti* and *Polypori* on old trees and logs.

Very few species are attached to any particular kind of fungus. A piece of *Boletus* from Godalming once produced no less than seven species, representing the four genera *Cis*, *Ennearthron*, *Octotemnus*, and *Rhopalodontus*.

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* Communicated by the SECRETARY.

At first one experiences some difficulty in naming specimens owing to the confusion of species and the presence of many imperfect or immature examples in the older collections available for study and comparison.

Colour variation is a constant source of difficulty owing to the fact that it might be due either to simple aberration or to different degrees of maturity of the specimens.

The colour of the clubs of the antennæ, sometimes mentioned as a guide to the identification of species closely related, must not be accepted as a reliable character without allowance for variation. I have studied great numbers of living specimens, from emergence from the pupa to undoubted maturity, and the results of my investigations enable me to say in which of the species this character is regular, or the reverse.

Any uncertainty or difficulty relating to immaturity may be avoided by breeding and keeping the insects alive for several months.

The breeding-process is very simple, and consists of gathering infested fungi, which may be kept in carefully labelled tins or jars in a cool situation, where the insects may develop under healthy conditions. A little damp blotting-paper or peat will supply all the necessary moisture, care being taken that sufficient ventilation is provided to prevent mildew.

Most of the species are long-lived, and may be found in the larval or adult state at any season. Pupation appears to be unusual in winter, but sometimes occurs in sheltered situations.

In the formation of the following table of the genus *Cis*, for which I claim little more than the merits of simplicity, I have to some extent grouped the species, as I have found them confounded in collections. For instance, the series of *C. micans* in the National Collection at one time consisted of four different species, viz.:—*C. micans*, *C. setiger*, *C. boleti* (small and immature), and *C. hispidus* (immature).

The general characters of shape and size will enable the student without figures or reference-collections to decide to which of the five groups his specimens belong before attempting the more difficult task of specific identification.

Table of Genera and Species.

Genus Cis Latreille.

Antennæ 10-jointed. Anterior coxæ transverse, round-oval; tibiæ not (or very rarely) dilated at apex.

Group 1.—Form short. Almost glabrous. L. 1¼ 1⅝ mm.

C. lineatocribratus Mell. Elytra strongly punctured in rows. Never black. Clubs of antennæ always pale.

C. nitidus Herbst. Colour pale brown to black. Clubs of antennæ always dark. Anterior angles of thorax produced.

C. jacquemarti Mell. Colour pale brown to black. Clubs of antennæ always pale. Anterior angles of thorax not produced.

Group 2. Form short. Plainly pubescent. L. 1½–2 mm.

C. bilamellatus Wood or Fowler (=*minutus* Blackburn. Upper surface dull. Clubs of antennæ dark.

C. lineatosetosus, sp. n. Upper surface shiny. Clubs of antennæ pale.

Group 3.—Oblong. Rather broad. L. 2–4 mm.

C. boleti Scop. Thorax uneven, irregular impressions on disc, base not bordered. Clubs of antennæ pale testaceous or black.

C. setiger Mell.=*villosulus* Marsh. Impressions on thorax more or less obsolete, base bordered. Clubs of antennæ pale testaceous or black.

C. micans F. Never quite black. Clubs of antennæ always dark.

C. hispidus Payk. Mature specimens always black. Clubs of antennæ always pale red.

C. bidentatus Ol. Dull. Scanty pubescence.

Group 4.—Elongate. Large. L. 2¼–2¾ mm.

C. alni Gyll. Shiny. Finely punctured. Very scantily pubescent. Clubs of antennæ pale or dark. Tibiæ long and slender.

C. latifrons, sp. n. Not so shiny. Coarsely punctured. Distinctly pubescent. Head very broad. Clubs of antennæ pale. Tibiæ short and stout.

C. punctulatus Gyll. Dull. More coarsely punctured and with longer pubescence. Clubs of antennæ pale or dark.

Group 5.—Elongate. Size smaller. L. 1–2¼ mm.

C. oblongus Mell.=*pygmaeus* Marsh. Black. Legs red or partly red and black Clubs of antennæ variable, pale or dark. Pubescence usually reddish, rarely yellow or white.

Females sometimes much above average size of this group.

C. vestitus Mell. First ventral segment of abdomen of male bearing a small umbilicate depression in the middle (Newbery). Colour variable, but rarely black. Legs ferruginous, never red or black and red. Clubs of antennæ pale or black. Upper surface dull.

C. festivus Panz. First ventral segment of abdomen of male rugose all over, but with no umbilicate depression in the middle (Newbery). Clubs of antennæ always pale. Upper surface shiny.

C. castaneus Mell. = *fuscatus* Mell. Unicolorous castaneous. Depressed and dull. Clubs of antennæ never black.

Genus RHOPALODONTUS Melliè.

Antennæ 10-jointed. Anterior coxæ shorter (more or less conical); tibiæ dilated and denticulate at apex.

R. perforatus Gyll. Size larger. Dull unicolorous. Pale or dark brown. Clubs of antennæ never black. L. 1½–2 mm.

R. fronticornis Panz. Size smaller. Dull black, with pale testaceous legs. Clubs of antennæ sometimes black. L. 1–1⅓ mm.

Genus ENNEARTHRON Melliè.

Antennæ 9-jointed.

E. affine Gyll. Colour black. Clubs of antennæ alway dark. L. 1–1½ mm.

E. cornutum Gyll. Colour brown. Clubs of antennæ usually dark, rarely pale. L. 1–1¾ mm.

Genus OCTOTEMNUS Melliè. (*Orophius* Redtenbacher.)

Antennæ 8-jointed.

O. glabriculus Gyll. Smooth, shiny. The number of joints of the antennæ will distinguish it from *Cis jacquemarti* in Group 1. L. 1–1½ mm.

Notes on Characters and Distribution, with Description of New Species.

Genus CIS Latreille.

C. LINEATOCRIBRATUS Mell.

There is little or no variation noticeable amongst mature specimens.

Previously only recorded from Scotland and Cumberland (Day). The latter record (Brit. Col., Fow. & Don. vol. vi. p. 281) refers to a single specimen taken from fungus on birch at Gt. Salkeld by Mr. H. Britten. Abundant in a large detached brown fungus at Mark Ash, New Forest, Sept. 1913 (Pool). Near Brockenhurst (Dr. Sharp), Denny Wood (Bedwell).

C. NITIDUS Herbst.

Common and widely distributed throughout Britain.

Ireland, common in Dublin and Belfast districts.

It is found in Scotland in company with *C. jacquemarti* Mell., and is sometimes confounded with that species in collections.

C. JACQUEMARTI Mell.

Previously only recorded from Scotland, where it has been taken freely at Rannoch (Turner, Beare, and Donisthorpe), Garve in Ross-shire (Dr. Joy). Near Brockenhurst, 1915 (Dr. Sharp), in company with *C. nitidus* Herbst.

Not recorded from Ireland.

C. BILAMELLATUS Wood = *bilamellatus* Fowler (Europ. List Heyden, Reitter & Weise, 1906) = *minutus* Blackburn.

There is some considerable variation in size and development of the males. Small specimens occur without the upright plates on the thorax and clypeus, which might easily be mistaken for females or for members of another species.

Additional localities: Orpington, Kent (Pool), Richmond Park (Donisthorpe & Perkins), Highgate (Janson).

It has occurred at Port Lincoln, South Australia, and was named *C. minutus* by Blackburn, with whose type I have compared British specimens.

Exceeding abundant in Kent and Surrey, but is probably an introduction like the following species.

C. LINEATOSETOSUS, sp. n.

Short and broad, unicolorous testaceous, shiny. Head smooth, finely punctured and pubescent. Thorax finely punctured and pubescent, slightly narrowed in front, front margin with two indistinct teeth which merge with two other more distinct teeth on the clypeus when viewed from behind. Elytra twice as long as thorax, broad, closely punctured, especially near the scutellum, and clothed with ten straight rows of erect setæ. Legs and antennæ entirely pale testaceous.

Length 1½ mm.

This insect resembles the small undeveloped males of *C. bilamellatus*, which bear only slight traces of the plates on the thorax and clypeus. It is not an indigenous species, but because of its long residence in London and the possibility of its having become established in our parks or woods, it is desirable that its origin should be recorded with these notes on species found in Britain.

Several specimens are in British collections, which I have traced to the following source:—

"86. In a fungus from the South Sea Islands that had been many years in Mus. Brit. (alive). From W. Carruthers, Esq., Sept. 1866."

I am indebted to Mr. J. N. Halbert of the National Museum, Dublin, for this extract from Dr. McNab's notebook. It is of special interest as showing how *C. bilamellatus* might have been imported from South Australia.

My specimen, given to me by Mr. O. E. Janson from his father's collection, bears a label with the following inscription:- "From Fungus in British Museum. Dr. McNab."

C. BOLETI Scop.

Exceedingly variable in size, colour, and punctuation of mature specimens.

A specimen from Sandown, which lived for five months, is entirely pale testaceous.

Pale examples occur with black clubs on the antennæ. Dark brown or black specimens may be found with either dark or pale clubs.

Rev. W. W. Fowler (Col. Brit. Is. p. 206, vol. iv.) says:

"The *Cis rugulosus* of Mellié, which was introduced into our lists by Mr. Crotch, appears to be only a variety of *C. boleti* in which the rugose punctation of the elytra is more apparent and the larger punctures more or less obsolete; as intermediate variations occur it can hardly be regarded as a stable variety, much less as a species."

My series of this and other species of *Cis* contains some remarkable aberrations, which I have refrained from naming as I consider the latter part of the remarks quoted might apply equally well to any of them.

Common in fungus on logs, stumps, etc., throughout the Kingdom.

C. SETIGER Mell. = *villosulus* Marsh.

Probably the most variable species of the genus in size and colour.

I possess specimens displaying the following combinations:—Body black with black clubs of antennæ; dark brown with pale clubs; pale testaceous with black clubs; and unicolorous testaceous.

Recorded from Lancashire, Cheshire, and Suffolk. Common in Southern Counties in company with *C. boleti*. Exceedingly abundant in the Isle of Wight.

Not recorded from Scotland or Ireland.

C. MICANS F.

No variation observable amongst mature specimens.

Recent records of localities:—Oxford and Chatham districts (Walker), Newbury (Harwood), Cumberland (Britten), New Forest (Dr. Sharp), Burnham Beeches, Bucks, and Fittleworth, Sussex (W. E. Sharp), Godalming, Surrey, bred in abundance from *Boletus*, which was also inhabited by *C. boleti* and *C. setiger* (Pool), Penarth (Tomlin).

Not recorded from Scotland or Ireland.

C. HISPIDUS Payk.

Pubescence usually bright reddish, but I have seen specimens with yellow or white pubescence.

Common and widely distributed throughout England.

I have never seen it in the Isle of Wight.

Taken in Scotland at Nethy Bridge (Beare) and Garve in Ross-shire (Dr. Joy).

Ireland: Maryborough (W. E. Sharp).

C. BIDENTATUS Ol.

This species is sometimes abundant in a large fungus on old elms, which also produces *Dacne rufifrons* and *Mycetophagus multipunctatus*.

Common and widely distributed throughout England.

Scotland: Rannoch, in an old *Polyporus* on birch, also inhabited by *C. nitidus*, *C. jacquemarti*, and *Bolitophagus reticulatus* L. (Donisthorpe).

Ireland: Armagh and Dublin.

I have not seen it in the Isle of Wight.

C. DENTATUS Mell.

Mr. Donisthorpe has withdrawn this species from the British list (Ent. Record, vol. xxviii. p. 155, 1916).

C. ALNI Gyll.

The specimen recorded as *C. dentatus* Mell. (Ent. Record, vol. xix. p. 136, 1907) is a curious aberration of *C. alni* with abnormally coarse punctation of the thorax.

There appears to have been some interruption of the pigment which gives the insect a strange greenish opaque appearance, only the scutellum having the normal dark brown colour.

Whilst withdrawing *C. dentatus* from our list, Mr. Donisthorpe proposes the name of var. *mitfordi* for this aberration of *C. alni*. For reasons already stated in connection with *C. boleti*, I am not following Mr. Donisthorpe in this direction.

This species appears to be common in most districts where elders are growing. It occurs under the bark of dead elder-stems upon which the curious black "Jew's ear" fungus is growing. It has been recorded in fungus on oak in Dunham Park, Manchester, and Professor Beare tells me he has taken it plentifully in fungus on dead birch boughs at Nethy Bridge in Scotland.

Calbourne, I. of Wight (Morley), Sandown (Mitford).

There appears to be only one Irish record, from Mote Park, Roscommon.

C. LATIFRONS, sp. n.

Black, elongate, parallel-sided, clothed with white outstanding pubescence, which, when examined under a lens, is very distinct on the sides of the thorax and elytra. Head with eyes nearly as broad as the thorax, finely punctured and pubescent. Thorax and elytra coarsely but evenly punctured. There is an impunctate line behind the middle of thorax equal in width to the space occupied by two of the surrounding punctures. Antennæ testaceous; clubs slightly darker. Legs red. Tibiæ short and stout.

Length 1½ 2½ mm.

This species comes near to *C. alni*, with which it has been confounded in collections. The longer pubescence, coarser punctation. as well as its shorter and stouter tibiæ, will easily distinguish it from that species.

I have recently taken two specimens from rotten beech to which is attached a small brown fungus containing *Cis* larvæ, collected with other fungi at Lyndhurst in September 1916. There is a specimen in the Power Collection from the New Forest. and another in the Waterhouse Collection taken in the same locality by Mr. Kemp. Another example without data is in the collection of Mr. H. Willoughby Ellis. It was along with some common New Forest species, so is probably from that district.

C. PUNCTULATUS Gyll.

This is now the only undoubted British species of *Cis* which has not been recorded from the south of England. Orton Woods, nr. Carlisle (Day & Britten).

Scotland: Braemar, Aviemore, Nethy Bridge, Balmuto, Rannoch and Peebles. Professor Beare tells me the species lives in a white fungus which develops between the wood and the bark of dead Scotch fir.

Not recorded from Ireland.

C. OBLONGUS Mell.=*pygmæus* Marsh.

Forest Hill, Dulwich, Horsell, Coombe Wood, Tonbridge, Windsor, Reading; Knowle, Warwickshire.

I have bred it in profusion from fungi gathered from oak posts, at Sandown and Brading, I. of Wight.

Chatham (J. J. Walker), Oxford (Collins), North Holt, Middlesex (W. E. Sharp), Brockenhurst (Dr. Sharp), Enfield and Epping Forest (Pool), Harlech (Donisthorpe). Exminster, June 1909. Abundant on old posts, Bovey (P. de la Garde).

Not recorded from Scotland or Ireland.

I have never found it accompanied by any other species of *Cis* and have never seen the imago alive in winter. It is an active creature in June and July, when I have seen it in numbers running in hot sunshine upon posts and tree-trunks infested with the fungus in which it feeds.

C. VESTITUS Mell.

A variable species, of which I have seen the following combinations:—

Body black, with pale testaceous clubs of antennæ, Wallington (Power). Black, with black clubs; pale testaceous, with black clubs; as well as unicolorous brown and smoky-yellow forms. I have never found *C. vestitus* and *C. festivus* inhabiting the same fungus together.

Forest Hill, Dulwich; Olton and Sutton Park, Staffs.; Manchester district; Teesdale; Epping Forest (Beare). Richmond Park (Donisthorpe).

I have bred it in plenty from fungus scraped from the underside of dead oak boughs from Enfield, Edmonton, Brockenhurst, and Sandown, I. of Wight. Widely distributed and not uncommon, but often overlooked or mistaken for *C. festivus*, with which I have seen it confounded in the Power and other collections.

Not recorded from Scotland or Ireland.

C. FESTIVUS Panz.

Clubs of antennæ always pale. Little or no variation in mature specimens.

Common and widely distributed in England and in I. of Wight. Usually found in fungi on oak posts or branches. Prof. Beare finds it every year with *C. alni*, in fungus on birch branches or faggots at Nethy Bridge. I have bred it in plenty from fungi from New Forest, Godalming, and Portsmouth district, but never in company with any other *Cis*.

Ireland (Boris); Queenstown (J. J. Walker).

C. CASTANEUS Mell.=*fuscatus* Mell.

The exchange list of British Coleoptera, Newbery & Sharp, 1915, shows the type-form of this species as not yet recorded from Britain.

This form actually represents the mature insect, which I have bred in great numbers from fungi from Enfield, Epping Forest, New Forest, Warlies Park, Essex, and Sherwood Forest. Richmond Park (Donisthorpe); Symonds Yat, Cardiff Cannock Chase, and Liverpool in a flour mill (Tomlin).

Immature specimens were called *C. fuscatus* by Melliè = *fuscatus* Mell. = var. *fuscatus* Newbery & Sharp, nec Mell.

C. ELONGATULUS Gyll.

First mentioned as British by Dr. Sharp (Ent. Mo. Mag. vol. viii. p. 83, 1871), who says Mr. Crotch considers he has Scotch examples of this species.

Dr. Sharp does not mention having seen the specimens.

There is a single specimen of a *Cis* in the Crotch Collection at the University Museum, Cambridge, standing in the name of

C. elongatulus. Unfortunately it has lost all of its legs and antennæ and is without data. It may be one of Mr. Crotch's Scotch examples, but I have failed to trace the others in any other collection.

The only other record of the species is Knowle, Wawickshire (Blatch) (Cat. Brit. Is., Fowler, vol. iv. p. 209). This is an error, as there is not even a label for *elongatulus* in the Blatch cabinet.

The position of this species in the British List depends entirely upon a single imperfect specimen of doubtful origin, and it probably remains for collectors in the north to prove if the Scotch record is justified

Professor T. Hudson Beare tells me he has never found any specimen in Scotland which in any way agreed with the description of this species.

I am indebted to Mr. H. Willoughby Ellis for allowing me to study the Cissidæ in the Blatch Collection, and to Mr. Hugh Scott for the loan of the Crotch specimen for examination.

Genus RHOPALODONTUS Mellié.

R. PERFORATUS Gyll.

There are not any recent records of this insect, which has only occurred at Rannoch in Perthshire. Bred with *Cis nitidus*, from a hard *Boletus* found on old birch trees in the Black Forest (Foxcroft, 1853 4). The last record was Rannoch (Turner, 1858).

R. FRONTICORNIS Panz.

I have bred this species in plenty from fungi on elm and willow and beech from Epping Forest, Enfield, Cheshunt, Godalming, and have taken it in small numbers at Brockenhurst and Orpington, Kent.

Bovey Tracey (P. de la Garde, 1909, fungus on sallows); Oxford district (J. J. Walker); Kerne Bridge, Newbury (Tomlin).

Not recorded from Scotland or Ireland.

Genus ENNEARTHRON Mellié.

E. AFFINE Gyll.

I have taken this insect at Brockenhurst, Sherwood, Epping Forest, Sandown, I. of Wight, Millwall Dock in fungus on aspen log with *C. setiger* and *Dermestes frischi*.

Windsor, Ashdown Forest (W. E. Sharp); Sheppey, Oxford, and Chatham (J. J. Walker); Teesdale, Durham (Bagnall).

Not recorded from Scotland or Ireland.

E. CORNUTUM Gyll.

Ditchingham, Norfolk (Beare), Ashdown Forest and Crowthorne (W. E. Sharp), nr. Exeter (Rendel). I have not seen it in the Isle of Wight. Bred in numbers from various fungi from Portsea Island, Horndean, Hants, Sherwood Forest, New Forest, Epping Forest, Warlies Park, Essex, Enfield, Orpington, Kent (Pool).

Not recorded from Scotland or Ireland.

Genus OCTOTEMNUS Mellié.

O. GLABRICULUS Gyll.

No variation observable amongst mature specimens.

I have seen pale immature specimens in an old collection under the name of *Cis flavus* Kirby.

Abundant everywhere in *Boletus* on various trees.

2. A new Species of the Coleopteran Genus *Cryptorrhynchus* Illiger.

C. HARRISONI, sp. n.

Black, rostrum stout, slightly narrowed in centre, almost glabrous shiny and red in front: centre sparingly and base thickly clothed with elongate white scales. Antennae red and shiny. Thorax rounded at sides, narrowed at apex, coarsely and closely punctured, sparingly clothed with white scales. Scutellum dull black, finely punctured. Elytra densely clothed at base and apex with white and yellow scales, and more sparingly with similar scales in the centre and marked with straight rows of large shallow punctures, smooth between rows, very finely punctured near suture. Legs dark reddish, clothed with elongate white scales: femora with a distinct tooth; tarsi red.

Length 3 mm.

A single specimen was taken by Mr. F. A. Harrison at Frinton-on-Sea, Essex, during the summer of 1915. Unfortunately Mr. Harrison does not remember the circumstances of its capture.

It may be an importation, but, like *Catharmiocerus maritimus* and other exceedingly local coast weevils, it might easily have been overlooked, especially as the locality appears to have provided but few attractions for British collectors.

EXHIBITIONS AND NOTICES.

February 6th, 1917.

Prof. E. W. MacBride, D.Sc., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the Additions made to the Society's Menagerie during the months of November and December 1916:--

November.

The registered additions to the Society's Menagerie during the month of November were 60 in number. Of these 50 were acquired by presentation, 8 were received on deposit, and 2 by purchase.

The number of departures during the same period, by death and removals, was 115

Amongst the additions special attention may be directed to:—

2 Grizzly Bears (*Ursus horribilis*), from North America, deposited on November 21st.

December.

The registered additions to the Society's Menagerie during the month of December were 27 in number. Of these 15 were acquired by presentation, and 12 were received on deposit.

The number of departures during the same period, by deaths and removals, was 120.

Amongst the additions special attention may be directed to:—

1 Sing-Sing Waterbuck (*Cobus defassa*) ♂, from W. Africa, deposited on December 8th.

1 Kashmir Deer (*Cervus hanglu*) ♀, from Kashmir, presented by H.G. The Duke of Bedford, K.G.

Mr. Edward Gerrard, on behalf of Mr. Crabb, exhibited a mounted specimen of a bird bred and reared in captivity under conditions in which it seemed certain that it was a hybrid between a male Thrush (*Turdus musicus*) and a female Blackbird (*Merula merula*).

February 20th, 1917.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President, in the Chair.

The SECRETARY read the following report on the Additions made to the Society's Menagerie during the month of January 1917:—

The registered additions to the Society's Menagerie during the month of January were 118 in number. Of these 49 were acquired by presentation, 58 were received on deposit, 5 by purchase, 4 in exchange, and 2 were born in the Gardens.

The number of departures during the same period, by death and removals, was 128.

Amongst the additions special attention may be directed to:—

1 White-bellied Hedgehog (*Erinaceus albiventris*), new to the Collection, from Dakar, Senegal, presented by Mrs. C. H. A. Reaney on January 20th.

1 Greater Double-collared Sunbird (*Cinnyris afer*), new to the Collection, from South Africa, presented by Alfred Ezra, F.Z.S., on January 4th.

1 Three-lined Snake (*Trimerorhinus tritæniatus*), new to the Collection, from Nakuro, British East Africa, presented by R. Holmes on January 19th.

12 Beautiful Tree-Frogs (*Hyla pulchella*), new to the Collection, from Cordova, Argentine, presented by W. A. Smithers, C.M.Z.S., on January 29th.

Mr. D. SETH-SMITH, F.Z.S., Curator of Birds, exhibited the trachea from a male *Anseranas semipalmata*, showing its extraordinary convolution, which had been described by Latham so long ago as 1797. The exhibitor stated that neither in this species nor in *Phonygama keraudreni*, another species with a greatly developed convoluted trachea, did the birds produce any great volume of sound, such as might be expected from so elaborate an arrangement.

Notes from the Caird Insect House.

Mr. C. J. C. POOL, Assistant Curator of Insects, read the following notes upon species bred and exhibited.—

LEPIDOPTERA.

The Magpie Moth (Abraxas grossulariata).

Vast numbers of larvæ were collected in North London district and turned out upon *Euonymus* plants. This species is a good exhibit as it is visible in all stages.

A long series of varieties have been preserved and are now exhibited. The larvæ display considerable variation of colour, some of them being almost completely black. I was advised to isolate these melanic forms with the idea of producing some unusually dark imagos. I selected 73 melanic larvæ, but the results were disappointing, and I found the adults merely varied like those bred from unselected larvæ.

ODONATA.

Dragon-flies in the earlier stages have done well in the tanks. The following species have been bred: *Æschna grandis*, *Æ. juncea*, *Brachytron pratense*, *Libellula quadrimaculata*, *Orthetrum cærulescens*, and *Agrion puella*. Specimens have been preserved, together with the nymph skins from which they emerged.

We have no difficulty in rearing these creatures, as they feed upon other insects bred in the tanks; our trouble begins with the emergence of the Dragon-fly, which is a very fastidious feeder and will only take insects in active flight in hot sunshine.

The right conditions are obtainable only in an outdoor enclosure, which we hope to provide later, to exhibit these creatures during their natural adult life, which varies from one to three months.

COLEOPTERA.

Teratological specimens.

Tetropium gabrieli.

Some larch logs were received from Sutton Park, Staffordshire, infested with larvæ of this species.

One adult specimen, which emerged in the house, has malformed antennæ, the right member of the pair having an additional branch consisting of five joints.

Donacia linearis.

Specimens were collected at Waltham Abbey and exhibited on reeds in a shallow tank.

One specimen has ten instead of eleven joints to the antennæ, the eighth joint on each side being almost equal in length to joints 8 and 9 of a normal specimen.

Bananas as Food for Beetles.

The problem of providing suitable food for various species of Coleoptera, whose ordinary feeding-habits are as different as those of the lion and the lamb, has been solved in the Insect House by using the banana.

The following list of beetles and their ordinary foods, from which, under natural conditions, some of these insects are rarely, if ever, found very far distant, will form an interesting record of species which during the years 1915-1916 have been found to thrive partly or wholly upon this fruit:—

Voracious ground-beetles.	Ordinary Food.
Carabus violaceus.	Usually other insects.
,, *nemoralis.*	,, ,, ,,
,, *glabratus.*	,, ,, ,,
,, *auratus.*	,, ,, ,,
,, *catenulatus.*	,, ,, ,,
Calosoma inquisitor.	,, ,, ,,
Pterostichus vulgaris.	,, ,, ,,
,, *ater.*	,, ,, ,,
,, *madidus.*	,, ,, ,,
Harpalus ruficornis.	,, ,, ,,
Aquatic species.	
Hydrophilus piceus.	General scavenger, vegetable or animal matter.
Wood-boring species.	
Dorcus parallelopipedus.	Moist rotten wood (comes to sugar).
Saperda carcharias.	Foliage and bark of young stems of poplar.
Clytus mysticus.	Hawthorn blossom.
,, *arietis.*	,, ,,
Aromia moschata.	Flowers; sap and foliage of willow.
Hylobius abietis.	Fir bark.
Hylesinus crenatus.	Ash bark.
Scolytus destructor.	Elm bark.
,, *intricatus.*	Oak bark.
Elater pomonæ.	Flowers in summer (larva in decayed beech).
Dung-feeding species.	
Geotrupes spiniger.	
,, *stercorarius.*	
,, *sylvaticus.*	Horse-dung or decayed fungi.
,, *typhæus.*	Rabbit-dung.
Plant-feeding species.	
Chrysomela fastuosa.	Leaves of sallow.
,, *gramnis.*	Leaves of sallow and wild mint.
,, *hyperici.*	Leaves and flowers of hypericum.

Adult Insects which do not feed.

It is well known that many species of Lepidoptera, of which the Atlas Moth of India is a good example, are incapable of feeding in the adult state. The larva, when full fed, having enclosed itself in a protective cocoon and changed to the pupa, has provided itself with sufficient nourishment to sustain it over the very often far distant period of short, if energetic, adult life. The length of life varies according to temperature, which if high will produce great nocturnal activity, quickly exhausting the energy of the insect. Prof. H. M. Lefroy says these creatures usually become a complete wreck in three nights in the tropics. I have frequently kept them alive and in almost perfect condition for from 10 to 16 days by transferring them to a cooler case immediately after emergence from the cocoon.

Little has ever been written about the feeding-habits of Coleoptera belonging to the Longicorn group, often referred to as wood-feeders, which is generally only correct as regards the larvae.

I have studied these beetles alive, both in the field and in captivity, and it is my opinion that in their feeding-habits as adults we must regard them under two headings, viz., those which feed upon flowers or foliage of various plants and trees and those which, like the Atlas Moths, do not feed at all.

Those which feed may be seen in active flight or settled upon their food plants in hot sunshine.

The following list includes the nocturnal species tested in the Insect House, and which I have failed to attract with any of the foods which appeal to the diurnal species :—

Prionus coriarius.
Asemum striatum.
Tetropium gabrieli.
Criocephalus polonicus.
,, *rusticus.*

Experiments with living Specimens of the Sexton Beetles Necrophorus humator (black) *and* N. ruspator (red and black).

Offered as food to the following animals in the small Mammal house :—

Egyptian Mongoose.—Seized and devoured both species without hesitation.

S. American Coati.- Lost sight of the first beetle, but afterwards sniffed and followed its trail right across the cage. It then picked up the beetle in its mouth, and, after spitting it out several times, finally devoured it.

The White Marmoset.—This little animal never refuses an insect, but there was some hesitation about attacking these foul-smelling beetles. However, its love of insect-food overcame everything else, and after much sniffing and spitting two were devoured.

The Meercats.—Smelt, but would not touch, either species. I often feed these animals with such species as *Dytiscus marginalis*, *Carabus violaceus*, and *Geotrupes sylvaticus*.

Capuchin Monkeys. These animals seized both species readily. One female monkey satisfied herself with eating some of the numerous parasitic mites from the body of the beetle. A male monkey ate three beetles, and then stole and devoured the one held by the female.

March 6th, 1917.

Dr. S. F. Harmer, Sc.D., F.R.S., Vice-President,
in the Chair.

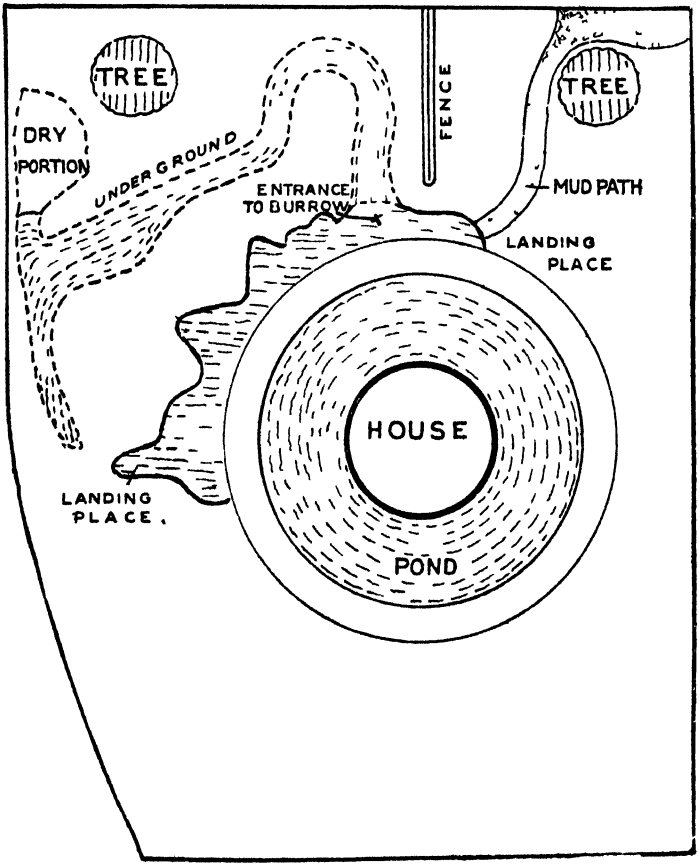
Work of the Beavers in the Society's Gardens.

Mr. R. I. Pocock, F.R.S., F.Z.S., Curator of Mammals, gave an exhibition illustrated by lantern slides to show the work of the Beavers in the old enclosure in the Gardens, and remarked:

"Until the middle of 1913 the pair of Canadian Beavers had shown no special activities of any kind, apart from felling in characteristic manner the tree-trunks erected for that purpose. In the summer of 1913, however, a shallow pool appeared in the surface-clay of their enclosure. This they proceeded to deepen and widen by digging out the bottom and sides. They carried away the excavated clay and plastered it in different places, especially up against the fence. From the enlarged pool they drove an open channel through the soil for about a couple of yards, but this they soon roofed over with small logs and straw plastered with mud, so that their subsequent operations were concealed from view. But from the end of the channel and continuous with it, as it afterwards transpired, they dug out a burrow nearly three yards in length and passing under the root of a witch elm. The first intimation we had of this was the appearance of a hole, smaller than a rabbit's burrow, close to the fence on the side remote from the pool where the channel started. This hole they built up with tufts of straw and a small log or two, possibly to prevent the clay falling in.

When I opened the burrow to satisfy myself that it was not being carried beneath the fence, it appeared to me that the hole at the end was a ventilator. At all events no attempt had been made to enlarge it for exit or entry, and the part of the burrow it opened into was a comparatively large chamber, wide enough for the beavers to turn about in and deep enough for them to immerse themselves under the water. The narrower part of the burrow was from $1\frac{1}{2}$ to 2 ft. wide and about 2 ft. deep from the surface of the ground, the soil of its roof being only a few inches thick. It was rather more than half full of water, continuous with that of the pool at the entrance, which we subsequently found proceeded from a burst underground pipe.

Text-figure 1.



Plan of the old enclosure for Beavers showing the work done by the animals.

In the evening of the day on which the burrow was opened one of the beavers started to repair the damage done, using straw, branches, and mud for the purpose. The task occupied him off and on the whole of the day following. He dug up the wet clay from the bottom of the burrow and plastered it with his paws over the straw and branches which he had previously laid in place to roof the open channel.

From that date until the summer of 1916 the burrow was left undisturbed and two litters were born in it. The beavers, however, were never idle. Working from the pool, at the entrance of the burrow, they dug out a channel in an opposite direction from the first, but roughly in the same line for a few yards, then turned it with a sharp bend towards the artificial pond in the centre of the enclosure. This channel was roofed over in the same way as the first. In the meantime they had excavated a trench up against the concrete wall of this pond on the side where the burrow was situated, and the roofed-in channel was continued till it communicated with this trench, which was deep enough for the beavers to swim in except at one or two places on the margin where shallow landing-places were made.

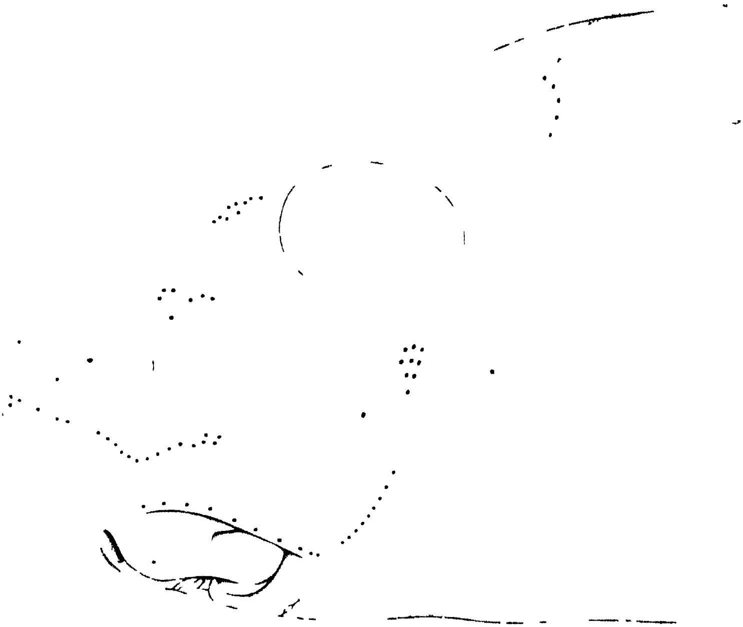
So long as the beavers were supplied with straw, branches, and logs, they employed them continually for strengthening the roof of the burrow or heightening the roof of the terminal portion up against the fence. When the enclosure was done away with in 1916, this portion where the burrow ended was found to consist of a comparatively large chamber partly filled with water; but at the very end towards the trunk of the witch elm above referred to, there was a flat dry platform above the level of the water and about large enough to accommodate two beavers and their young. There was no bedding on this platform, merely a scanty covering of wood-chips. This part of the burrow was ventilated through chinks in the fence left open by the beavers, and from it a narrow passage, ending blindly, ran in the direction of the trench, and would probably have been carried through to it, giving the burrow a second entrance.

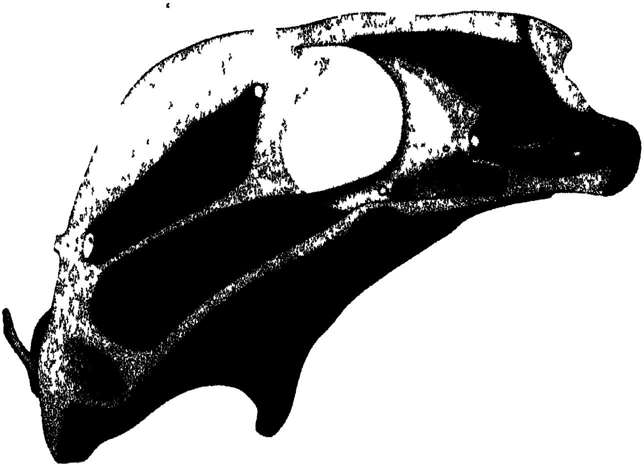
The main points in the structure of the burrow are shown in the plan of the enclosure (fig. 1, p. 101). The circular central area is the brick-house surrounded by the concrete pond, and the mud path is a beaten track along which the beavers used to carry the mud to pile up against the fence.

I have watched the beavers at work night after night, and can confirm the observation of others as to their methods and activities. They carry mud in their fore-paws tucked up against the throat and chin and walk the while flat-footed on their hind feet, with a kind of awkward waddle, the tail trailing behind and acting as a support and balance. Mud is laid on with the fore-paws to fill up chinks between branches and left to dry. It is never smeared over or pressed down with the tail, but sometimes it is jammed tightly home with the muzzle.

In the warmer months of the year the beavers seem to be pervaded with a restless energy, driving them to work with the materials at hand, whether there was anything to achieve or not. Their industry is certainly wonderful; but I was equally struck by the amount of absolutely aimless work they put in. Time and again I have seen a beaver, with infinite labour, haul a log out of the pond, pull it over the rough ground up to the top of the burrow and lay it there; then seizing it again, tug it back to the spot he started from. I have never seen any indication of intelligent co-operation between two beavers in shifting a log too heavy for one. If two get hold of the same log they do not work together and haul it in one direction, but tug and push in such a way that the efforts of the one counteract those of the other."

P Z S 1917 ALLIS,





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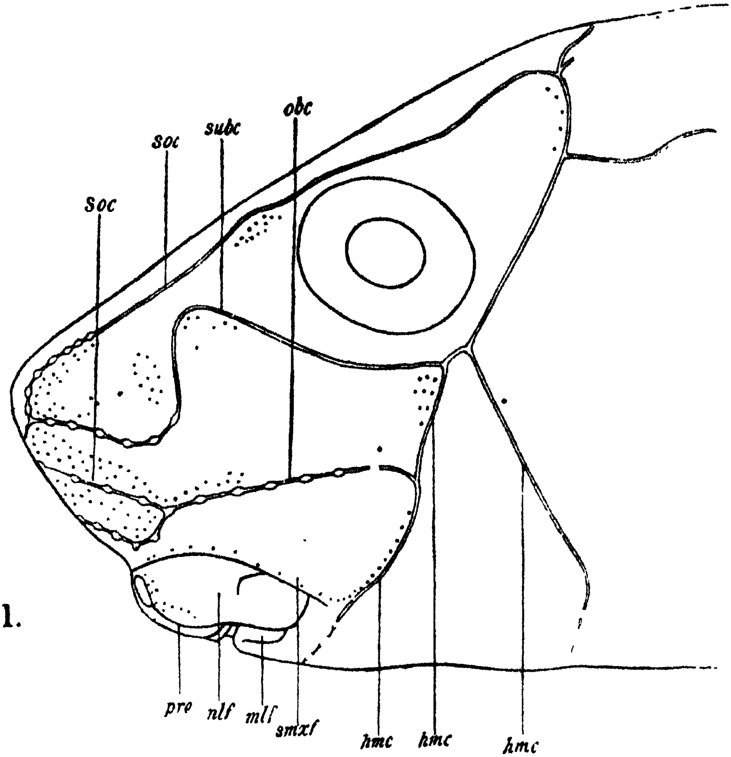
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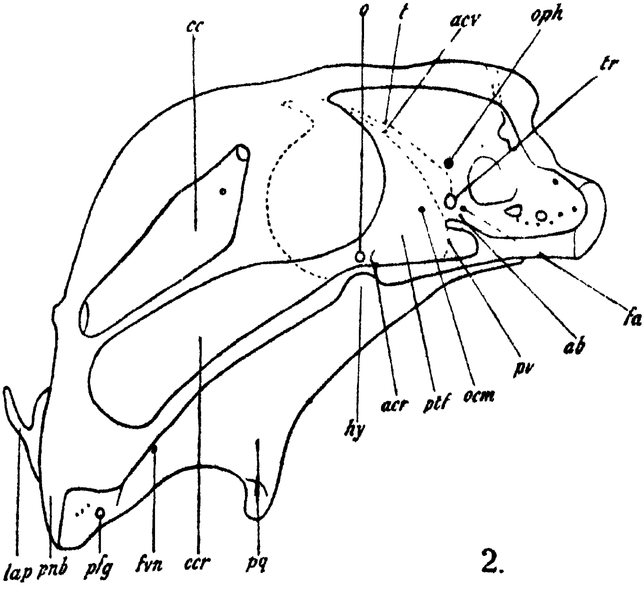
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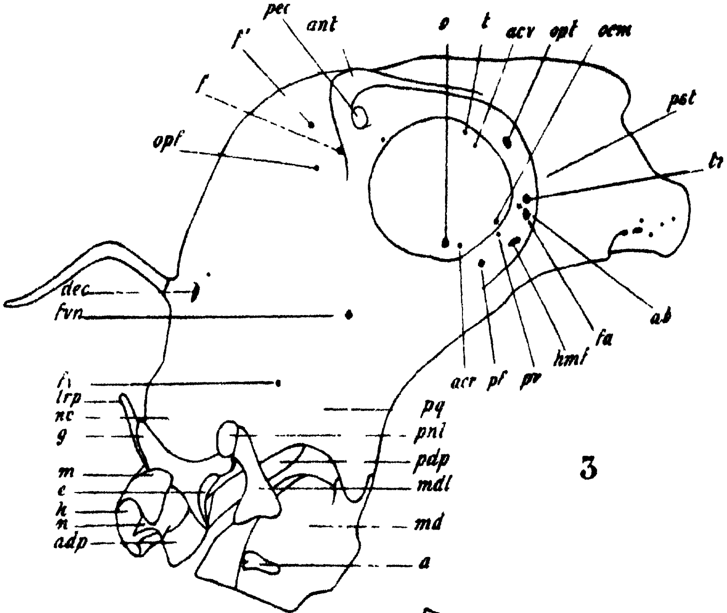
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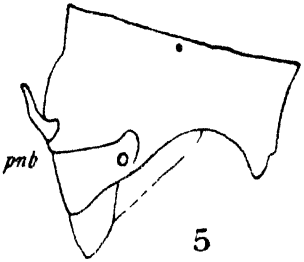
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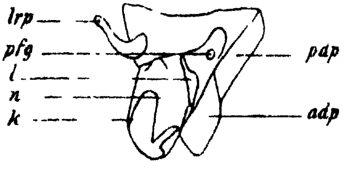
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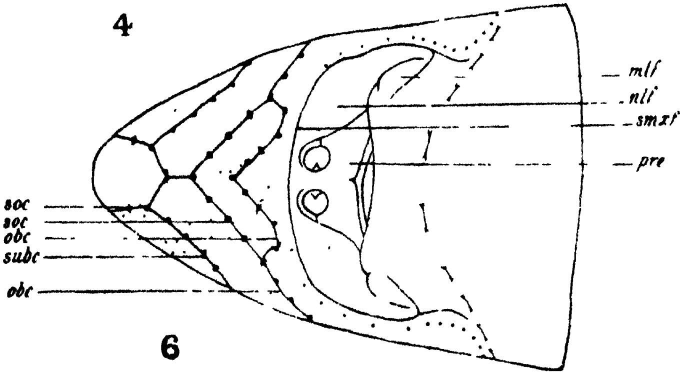
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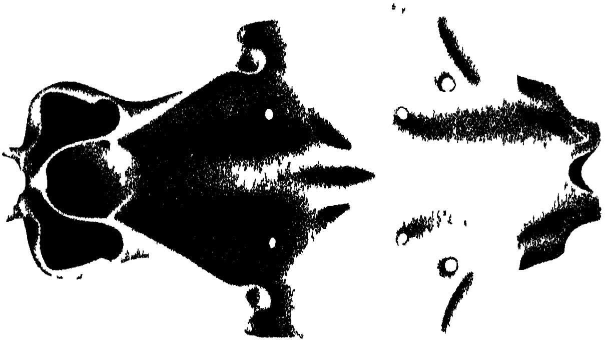

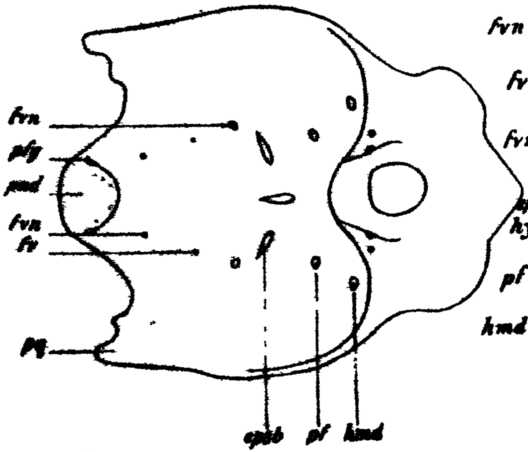
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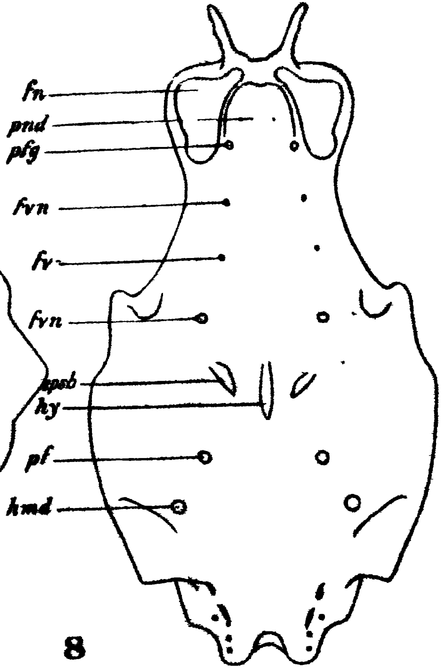
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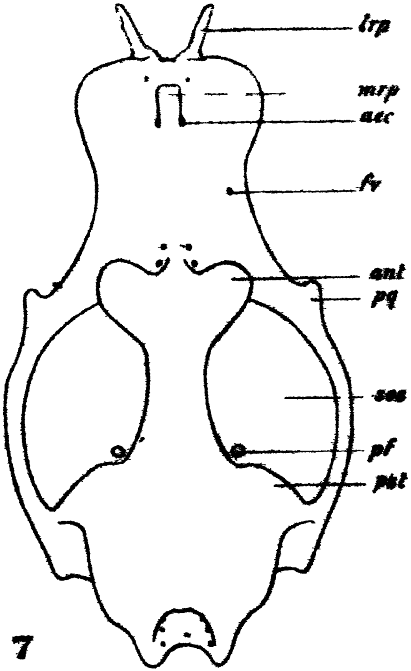
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PAPERS.

7. The Prechordal Portion of the Chondrocranium of *Chimæra colliei*. By EDWARD PHELPS ALLIS, Jun., F.Z.S.

[Received December 27, 1916, Read March 20, 1917.]

(Plates I.-III.*)

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The prechordal portion of the chondrocranium of the adult *Chimæra* is directed ventro anteriorly, and not anteriorly as Hubrecht's (1877) figure of this fish would lead one to suppose. This is unquestionably due to the trabeculæ having been first laid down at a marked angle to the parachordals, and to their having retained, to a marked extent, that primitive position, instead of, as in the Selachii, later gradually acquiring a position approximately in the line prolonged of the parachordals. The chondrocranium of *Chimæra* at these early stages has unfortunately not been described. It has, however, been described at these stages in certain of the Selachii, and at slightly later stages in *Callorhynchus*, and reference must be made to the conditions in these embryos of these fishes before describing those in the adult *Chimæra*.

SELACHII.

In *Acanthias* and *Pristiurus*, and hence probably in all of the Selachii, the cranial flexure is so great when the neurocranium begins to chondrify that, as shown in Sewertzoff's (1899) figures of embryos of these fishes, the parachordals and the enclosed notochord project slightly into the hollow of the mesocephalic flexure (plica encephali ventralis, von Kupffer, 1906). The trabeculæ cannot, accordingly, be laid down in the line prolonged of the parachordals, and, preserving their normal relations to the ventral surface of the brain, they at first lie at right angles to the parachordals and slightly posterior to their anterior ends. The marked cranial flexure at this stage also affects the position of all the visceral arches that lie anterior to the hyal arch, and the palatoquadrate and mandibula, which represent either the cartilaginous bar of the mandibular arch alone, or that bar together with parts of the bars of one or more premandibular arches, lie, when first laid down, at right angles to the trabeculæ, and hence in a nearly horizontal instead of a vertical position. Because of this, and also because of the relatively much greater development of these bars, they have crowded the bars of the more posterior arches posteriorly to such an extent that their dorsal ends lie in the auditory and spinal regions. The sphenolateral cartilage of either side (alisphenoid, Sewertzoff) lies, at this stage, in the horizontal plane of the parachordals, lateral to the hollow of the plica encephali ventralis. The nervi facialis, trigeminus, and ophthalmicus profundus all run outward postero-dorsal to this cartilage, the oculomotorius and opticus, and apparently also the trochlearis, running outward antero-ventral to it. In slightly older stages an ethmoidal cartilage is developed, which begins at a point ventral to the lateral edge of the trabecula of its side, and ventral to the eyeball, and runs dorso-anteriorly dorsal to the nasal sac.

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* For explanation of the Plates see p. 143.

When the cranial flexure later becomes reduced, there is first formed, in *Pristiurus*, and hence probably in all the Selachii, a pronounced pontial flexure, but this flexure also becomes later reduced, and almost entirely disappears in the adult. During these changes the trabeculæ curve forward, or forward and upward, following the curved ventral surface of the brain, and this change in their direction and position affects the mandibular branchial bars, which, retaining their perpendicular relations to the trabeculæ, swing downward and forward, and so acquire a position vertically beneath the latter cartilages. These mandibular bars had apparently already become attached to the hyal bars by connective or ligamentous tissues, and the latter bars and the bars of the branchial arches had become similarly attached to each other both dorsal and ventral to the branchial clefts. When the mandibular bars swung downward and forward they accordingly pulled on the more posterior bars, but as the dorsal ends of the hyal and branchial bars, and the ventral ends of the latter bars, had become attached to tissues in the region where they lay, they were relatively fixed in position, and the middle elements, alone, of each bar could be moved forward, the branchial clefts of course shifting forward with them. This gave rise to the sigma form of branchial bar actually found in the adults of these fishes. In the Teleostomi, where there is but little cranial flexure when the neurocranium begins to chondrify, the trabeculæ are laid down in the line prolonged of the parachordals. The mandibular branchial bars were accordingly there laid down approximately in a vertical position, and the bars of the more posterior arches, not being pushed posteriorly by them, retained their primitive attachment in the cranial region. The sigma form of arch was accordingly not impressed upon the bars of the branchial arches of these fishes.

The trabeculæ, in the older embryos described by Sewertzoff, have fused with each other in the median line anterior to the pituitary body, and been prolonged, as a wide median plate, to the nasal region. There the plate contracts abruptly and is prolonged between the nasal sacs as a narrow rostral stalk in *Acanthias*, but as a wide internasal plate in *Pristiurus*, the two structures evidently being, as they are said by Sewertzoff to be, strictly homologous. Anterior to the nasal sacs this stalk or plate expands laterally, on either side, and in *Acanthias* forms the rostral plate of Sewertzoff's descriptions, a median keel-shaped ridge projecting ventrally from its ventral surface and being continuous with a similar ridge on the ventral surface of the rostral stalk. In *Pristiurus* the rostral plate is said by Sewertzoff to be represented in the three bars of the rostral basket, the keel of the plate of *Acanthias* representing the middle bar of the basket of *Pristiurus*, and the lateral portions of the plate representing the lateral bars. This I consider to be an erroneous interpretation of the conditions, the rostral plate of *Acanthias* certainly including, with the three bars of the rostral basket of *Pristiurus*, the narrow strip of cartilage that, in the latter fish, runs laterally immediately anterior to the nasal sac and is called by Sewertzoff the cartilage *c*. This cartilage *c* is said by Sewertzoff to not yet be developed in the oldest embryos of *Acanthias* examined by him, but to be found in the adult as a bar of cartilage that cuts the fenestra olfactoria of embryos into two parts, the lateral one being the definitive foramen olfactorium, and the mesial one the basal communication canal of Gegenbaur's (1872) descriptions of the adults of certain of the Selachii. The large perforation of either side of the floor of the rostral basket of *Pristiurus* is accordingly said, in accord with Gegenbaur's earlier conclusion, to be a basal communicating canal strictly similar to the one found in the adult *Acanthias*, but greatly enlarged and shifted forward; this large perforation of the rostral basket of this fish, and the large opening that actually transmits the nervus olfactorius, thus together representing the fenestra olfactoria of embryos of *Acanthias*. In an earlier work (Allis, 1913), I came to the conclusion that these perforations of the rostral basket of the Carchariidæ and Scylliidæ were not basal communicating canals, and that they were "probably . . . simply defects in the cartilage (of the rostrum) due to the presence of the large number of ampullæ found in this region in these fishes," and this conclusion I consider to be confirmed by conditions that I have since found in one specimen of *Acanthias blainvillii*. In this specimen there is a basal communicating canal in normal position on each side of the head, and on one side of the head the rostral process is perforated by an irregular opening certainly strictly homologous to the perforations found in the Carchariidæ and Scylliidæ; and there are numerous ampullæ lying opposite the perforation.

The cartilage *c* of *Pristiurus* thus certainly corresponds to a part of the rostral plate of *Acanthias*, and the two cartilages of *Pristiurus*, one on either side of the head, can, for convenience, be together called the rostral plate, although they represent only a part of that plate as found in *Acanthias*. This plate and its stalk, in both these fishes, lie, at this age, in the line prolonged of the trabecular plate, and each lateral end of the narrow plate of the one (*Pristiurus*), and each postero-lateral corner of the broad plate of the other (*Acanthias*), turns dorso-posteriorly as a band-like process which passes dorsal to the nervus olfactorius and dorsal to the nasal sac, and, fusing posteriorly with the anterior ends of both the ethmoidal and sphenolateral cartilages, forms the dorsal boundary of the opening that transmits the nervus olfactorius; the sphenolateral cartilage quite certainly not taking any part in the formation of the actual boundary of the opening. This opening will be hereafter called the fenestra olfactoria in both these fishes, notwithstanding that it is said by Sewertzoff to be later subdivided into a foramen olfactorium and a basal communicating canal in *Acanthias*, and to represent the definitive foramen olfactorium in *Pristiurus*.

The nasal capsule of either side, as shown in Sewertzoff's figures, is represented by a curved plate of cartilage which encircles the basal portion of the anterior and lateral surfaces of the nasal sac and projects ventrally from the ventro-lateral surface of the rostral plate. It is completely fused, by its dorsal edge, with the rostral plate, but its position suggests that it is primarily an independent cartilage secondarily fused with that plate. Parker (1876) shows the nasal capsule in a somewhat different condition in *Scyllium*, but the figures given by him are difficult to comprehend and not readily compared with those given by Sewertzoff. The capsule, however, as shown by both these authors in these several fishes, lies ventro-lateral to the trabecular and rostral cartilages, and where, in these or others of the Selachii, the capsules of opposite sides have been pressed together so as to meet in the median line and there be separated only by a septum nasi, that septum lies ventral to the trabeculæ, as shown in Parker's sectional views of *Scyllium* and in Gegenbaur's sectional view of *Mustelus*. The trabeculæ, in each of these latter fishes, curve dorsally above the nasal sacs and are furnished with a deep median subethmoidal keel which extends ventrally between the sacs and is shown, in each case, as largely fenestrated in its middle portion. Parker (1876, p. 207) apparently considered this internasal septum to be an upgrowth of the trabecular cartilage, but Parker and Bettany (1877) say that the trabecular plate gradually rises to the level of the nasal roof and there suddenly narrows and is confluent with the internasal septum, this seeming to mean that the septum lies ventral to the trabeculæ, as I consider it to do. This difference in interpretation, by these two authors, of identical conditions is apparently due to Parker having considered the trabeculæ to be continued forward in the ventral edge of the subethmoidal keel, while Parker and Bettany consider them to be represented in the plate from which that keel descends, that is in the trabecular crest of Parker's descriptions.

A ventro-lateral trabecular process, lying antero-ventral to the nasal sac, is shown, slightly developed, in Parker's (1876) figures of embryos of *Scyllium*, the process there projecting laterally from the ventral edge of the subethmoidal keel. This process is called by Parker the cornu trabeculæ; but two other cartilages on each side of the head are also so designated by him, one being the cartilage *c* of Sewertzoff's descriptions, and the other the lateral bar of the rostral basket. This ventro-lateral trabecular process is not shown or described by Sewertzoff even in the oldest of his embryos, but that it is not peculiar to fishes in which there is a subethmoidal keel is shown by the conditions in the adult *Chlamydoselachus*, where the process is found well developed and there forming the anterior portion of the solum nasi of my descriptions of that fish (Allis, 1913).

The beginnings of a process that lies postero-ventral to the nasal sac is shown, in Sewertzoff's figures, at the ventro-lateral corner of the ethmoidal cartilage, and it is apparently it alone that is later prolonged into the important ventro-latero-posteriorly directed process that is currently called the antorbital or ethmo-palatine process. This antorbital process is, however, said to be formed, in certain other fishes and in higher vertebrates, by an outgrowth of the trabecular cartilage. It is therefore possible that there are two processes here, one of ethmoidal and the other of trabecular origin. If so, they are indistinguishably fused with each other in the Selachii, and to avoid confusion I shall call the process, whatever its origin, the ventro-lateral antorbital process, the entire antorbital process being considered to form the anterior wall of the orbit and to include both this ventro-lateral process and a more or less developed dorso-lateral process found in the adults of most fishes and frequently called the antorbital or preorbital process.

The sphenolateral cartilage has, in the oldest embryos of *Acanthias* described by Sewertzoff, grown forward and fused with the ethmoidal cartilage, and its supraorbital ridge, turning downward at its anterior end, forms the dorsal portion of the lateral edge of the antorbital process, that portion of that edge corresponding to the well-developed dorso lateral antorbital process found in certain other fishes. The ramus ophthalmicus superficialis trigemini and the nervus ophthalmicus profundus both, in younger embryos, run forward through the orbit and then dorsal to the nasal sac, passing external to the ethmoidal cartilage, between the dorso-lateral and ventro-lateral antorbital processes. But when the sphenolateral and ethmoidal cartilages fuse, the two nerves and an accompanying vein and artery become more or less enclosed between them, either separately or together. The nasal vein, which comes from the nasal pit to fall into the orbital venous sinus, also either becomes enclosed between these two cartilages or is enveloped in the lateral edge of the ethmoidal cartilage alone.

The nasal sac of embryos of the Selachii thus lies between four processes, more or less developed, two being derived from the trabeculæ and lying anterior to the sac, and two derived either from the trabecular, ethmoidal, or sphenolateral cartilages and lying posterior to the sac; and the nasal capsule, when it develops, also lies between and is more or less fused with these processes. The dorsal trabecular process and the ethmoidal constituent of the dorso-lateral antorbital process always fuse with each other above the nervus olfactorius, so forming the dorsal boundary of the fenestra olfactoria, and they also form, together with the sphenolateral cartilage, the lateral wall of the cavum præcerebrale of my descriptions (Allis, 1913). The two ventral processes may also fuse with each other at their outer ends, so forming a perforated plate which lies beneath the nasal sac, the perforation of this solum nasi being closed by membrane and representing an unchondrified portion of the nasal capsule.

The ventro-lateral antorbital process and the two prenasal processes of the Selachii are found in embryos of *Ceratodus*, the former being called by Greil (1913) the processus antorbitalis and the two latter the dorso-lateral and the anterior or lateral trabecular cornua. No dorso-lateral antorbital process is shown in Greil's figures of embryos of this fish, but it is shown by Furbringer (1904) in a figure of the adult *Ceratodus*, the process there apparently arising as a lateral process from the dorsal end of the posterior wall of the nasal capsule, and being called by Fürbringer the preorbital process. The septum nasi of *Ceratodus* apparently lies dorsal to the trabeculæ, as it does in the Teleostei. Holostei, and Crossopterygii, the septum in these several orders of fishes accordingly not being the homologue of the septum in the Plagiostomi, unless it be that the internasal prolongation of the trabeculæ of embryos of the former fishes corresponds to the ventral edge of the subethmoidal keel of embryos of the Plagiostomi and not to the rostral stalk and rostral plate, which seems quite probable.

CALLORHYNCHUS.

In *Callorhynchus*, as in *Acanthias* and *Pristiurus*, the trabeculæ are first laid down practically at right angles to the parachordals, as consideration of Schauinsland's (1903) figures of a 60 mm. embryo of this fish makes plainly evident. This is due, as in the Selachii, to the marked cranial flexure at this period; but in *Callorhynchus* the anterior portion of the brain, instead of recurving upward and forward as if seeking to reacquire a position in the line of the axis of the body, projects ventro-anteriorly in a straight line. Related to this retention, in this position, of this anterior portion of the brain, the eyeballs of the adult fish lie dorso-anterior to it; but whether it is this position of the brain that has forced the eyeballs to pass antero-dorsal to it, or the precocious development of the eyeballs that has prevented the brain from recurving upward, is not apparent.

The trabeculæ fuse to form a wide trabecular plate which, instead of curving gradually upward and forward, as in the Selachii, follows the straight line of the ventral surface of the brain until it reaches what Schauinsland considers to be the anterior end of the cranial cavity. There the trabecular plate, which at this age is still procartilaginous in its anterior portion, contracts abruptly to a narrow procartilaginous bar which lies at a marked angle to the trabecular plate, being directed dorso-anteriorly instead of ventro-anteriorly. This narrow procartilaginous bar is called by Schauinsland the "Septum im vorderen Schädelabschnitt," but it is evident that it is the strict homologue of the rostral stalk of the Selachii. The three rostral processes of Schauinsland's descriptions are all shown arising from this stalk, the median process from its dorsal end and the two lateral processes from its lateral edges at about the middle or dorsal third of its length. A short, plate-like subethmoidal keel has begun to develop on the external and hence morphologically ventral surface of the stalk.

From either side of the dorsal end of this rostral stalk, a band-like process runs laterally and then posteriorly, and, spreading dorsally and ventrally, fuses with the procartilaginous anterior portion of the ethmoidal cartilage, which cartilage forms the antorbital process and the anterior wall of the orbit. This band-like process is accordingly a dorso lateral trabecular process, similar to that in the Selachii, and the large opening enclosed between it, the rostral stalk, and the ethmoidal and trabecular procartilages should be primarily a simple fenestra olfactoria similar to that in the Selachii, but, even in the youngest embryos described by Schauinsland, the dorsal portion of the fenestra has apparently been already converted into a fenestra nasalis by the beginning of the development of the nasal capsule.

The development of the nasal capsule is not readily comprehended from the several figures given by Schauinsland. In the figures of the 60 mm. embryo (figs. 130–131) the capsule is not indicated by index-letters, but the lateral edge of the anterior opening of the cranial cavity is irregular, the dorsal portion projecting anteriorly beyond the ventral portion and occupying the place in which, in the 85 mm. embryo (figs. 124 126), the nasal capsule is shown. In an embryo said to be older than the 85 mm. one, but of which the length is not given, the nasal capsule is a dome-shaped protuberance of the dorso-lateral portion of the cranial wall immediately posterior to the actual anterior opening of the cranial cavity. Ventral to this so-called capsule the lateral wall of the cranial cavity runs evenly onward to the edge of the anterior opening of the cranial cavity, the capsule apparently not extending into this part of the cranial wall notwithstanding that the ventral portion of the nasal sac must certainly lie internal to it. The nasal sac also quite certainly does not project upward into the dome-shaped protuberance, that protuberance apparently lying above the nasal sac and resembling a dome-shaped swelling that I find, in the adult *Mustelus*, lying posterior to the foramen olfactorium and directly above the lobus olfactorius.

The dome-shaped protuberance of *Callorhynchus*, the so-called nasal capsule, always lies, at all stages of its development, in the region between the bases of the median and lateral rostral processes, and as the capsule increases in size the bases of the rostral processes are correspondingly separated from each other, and the anterior opening of the cranial cavity carried correspondingly forward; but whether this growth of the cranial wall takes place posterior to the fenestra olfactoria of the 60 mm. embryo, or is due to growth anterior to that fenestra, cannot be told from the figures. In the one case the nasal sac, which certainly lay primarily anterior and external to the cranial cavity, would have been pulled relatively backward into the anterior end of that cavity; the fenestra olfactoria of the 60 mm. embryo would remain morphologically unchanged, but would change in function from a fenestra olfactoria to a fenestra nasalis; and the so called nasal cartilages of Schauinsland's figures would represent detached pieces of an undeveloped nasal capsule. In the other case, the nasal capsule would be developed as a direct anterior, but morphologically ventral, prolongation of the cranial walls, a fenestra nasalis gradually developing external to the fenestra olfactoria of the 60 mm. embryo. The conditions in the adult *Chimæra* decidedly favour this latter view, but one of Schauinsland's figures of *Callorhynchus* equally decidedly favours the former view. The figure in question (fig. 165) gives a median vertical sectional view of an embryo older than the 85 mm. one, and shows the brain in place in the cranial cavity. The trabeculæ are shown lying in the line prolonged of the parachordals, which is not in accord with the figures of other embryos both older and younger than this one. The septal cartilage is shown as a simple rostral stalk, while in the younger, 85 mm. embryo, it is already an important plate-like structure the posterior portion of which corresponds to the rostral stalk of the 60 mm. embryo, and the anterior portion to the sub-ethmoidal keel of that stalk. The rostral stalk of the embryo shown in figure 165 projects dorso posteriorly, instead of, as in the other embryos, dorso-anteriorly, and the ventral portion of the nasal sac is shown extending forward anterior to the level of the base of the median rostral process and close to the ventro-anterior corner of the chondrocranium. The nasal sacs, as here shown, must accordingly project beyond the anterior openings of the cranial cavity, if those openings are found in this embryo at all in the positions that they have in the other embryos, both older and younger, and furthermore, they must lie dorsal to the trabeculæ, as they do in *Ceratodus* and the Teleostei, instead of ventral to the trabeculæ, as they do in the Selachii and as they must also in *Callorhynchus* if the septum nasi of this fish lies ventral to the rostral stalk, as shown in Schauinsland's other figures. There would accordingly seem to be some error in this figure 165.

The ethmoidal cartilage, as shown in these embryos of *Callorhynchus*, arises from the trabecular plate posterior to the fenestra olfactoria of its side, and runs dorsally and then anteriorly to meet and fuse with the band-like dorso lateral trabecular process. At its ventral end the ethmoidal cartilage gives off a lateral process which, even in the earliest stages shown by Schauinsland, has already fused completely with the palatoquadrate. The sphenolateral cartilage grows forward dorsal to the orbit, and in the 60 mm. embryo, where it is still procartilaginous, bifurcates anteriorly, one end passing dorsal and the other ventral to the ramus ophthalmicus superficialis trigemini, which nerve includes the lateralis fibres destined to supply the latero-sensory and ampullary organs of the region. The ventral one of these two ends of the sphenolateral cartilage has already fused, in this embryo, with the ethmoidal cartilage internal to the ramus ophthalmicus superficialis, and the dorsal end also later fuses with that cartilage but external to the ophthalmicus superficialis, this nerve thus being enclosed in a foramen and a dorso-lateral antorbital process being formed. This process is called by Schauinsland the preorbital process, and both it and the postorbital process are said by him to be primarily independent pieces of cartilage. Concomitantly with the formation of this process and the related foramen, a roof of cartilage has been formed over the nervi ophthalmicus superficialis trigemini and ophthalmicus profundus, enclosing them in a median canal called by Schauinsland the ethmoidal canal. This canal is evidently formed by the coalescence, in the median line, of two canals, one on either side of the head, each of these canals being formed by the roofing over of the groove that, in the Selachii, lodges the corresponding portion of the ramus ophthalmicus superficialis trigemini. In certain specimens of *Chlamydoselachus* I find these grooves partially roofed, either by lips of cartilage that project toward each other from the edges of the grooves, or by nodules of cartilage suspended in membranous strands that stretch across the grooves; and if this roofing process were to be completed and the grooves so formed pressed together in the median line, a median canal would be formed the roof of which would form the actual roof of the cranium and its floor the roof of the cranial cavity.

A remnant of the fenestra præcerebralis of my descriptions of the Selachii (Allis, 1913) is found, as will be later fully explained, in the small median opening marked *t* in Schauinsland's figures 124 and 125, and said by him to be a "Spalte, welche das Schädeldach von dem vorderen ethmoidalen Teil des Schädels trennt." The two large openings in the cranial roof that are called by Schauinsland the anterior and posterior divisions of the primarily single "Præfrontallücke," are not parts of the fenestra præcerebralis, and hence not parts of the Præfrontallücke of Gegenbaur's (1872) descriptions of the Selachii. The cavum præcerebrale, which in the Selachii lies directly anterior to the fenestra præcerebralis, cannot be represented in any part of the ethmoidal canal, for, aside from the origin of that canal as above explained, the floor of the canal is not formed by the trabeculæ, while the floor of the cavum præcerebrale is. The hind end of the ethmoidal canal is shown, in Schauinsland's figure 165, lying but slightly anterior to the anterior surface of the mid-brain. If this figure is correct, the membranous mesial walls of the orbits must accordingly, even in the oldest embryos considered by Schauinsland, be separated from each other by a considerable interval.

The chondrocranium of embryos of *Callorhynchus* thus apparently owes the several points in which it differs from that of the Selachii mainly, if not wholly, to the fact that that portion of the central nervous system that lies anterior to the plica encephali ventralis not only projects ventrally or antero-ventrally at the time when the trabeculæ are laid down, but that, for some reason, it has continued to lie in that position instead of later gradually curving forward or forward and upward. The trabeculæ still apparently seek to curve upward into the line prolonged of the parachordals, but, because of the interference of the overlying brain, this upward curve is found immediately anterior to the lobi olfactorii instead of, as in the Selachii, in the pituitary region.

The mandibular branchial bars were doubtless laid down primarily at right angles to the trabeculæ, and hence, as in the Selachii, in a nearly horizontal position, but as the trabeculæ later grow downward and forward instead of, as in the Selachii, curving gradually forward or forward and upward, the mandibular bars have been distorted. The dorsal ends of the processus oticus and basilaris, the latter representing the primitive dorsal end of the arch, apparently remain approximately in their primitive positions in relation, respectively, to the lateral wall of the otic capsule and the trabeculæ, but they have been stretched out into long cartilages by the marked ventro anterior growth of the trabeculæ, and the epal (quadrate) and ceratal (mandibula) elements of the arch lie in the region of the antorbital process. This will be again referred to when describing the conditions in *Chimæra*. Because of this distortion and change in position of the mandibular branchial bars, the branchial bars of the more posterior arches have also been carried forward and somewhat downward without having been previously pushed backward to the extent that they were in the Selachii, and the dorsal ends of the anterior branchial bars are shown lying in the cranial region in Schauinsland's oldest embryos. The sigma form of arch has, however, been impressed upon their dorsal ends, but not upon their ventral ends.

CHIMÆRA.

1. *Neurocranium.*

In a six-month embryo of *Chimæra colliei*, Dean (1906, p. 108) shows the trabeculæ projecting ventro-anteriorly at a marked angle to the parachordals, which would seem to establish that when first chondrified they lay, as they do in *Callorhynchus*, approximately at right angles to the parachordals. In the adult, the conditions shown by Dean in this embryo still persist to a marked extent, for, as shown in the accompanying figure (Pl. 1. fig. 2), the line of the vertebral column, if prolonged, would pass approximately across the dorsal edge of the postclinoid wall and issue from the cranium somewhat dorsal to the base of the median rostral process, the larger part of the prechordal portion of the cranium projecting ventro-anteriorly below this line at an angle of about 30°.

Because of this position of the trabeculæ, the mid-ventral line of the chondrocranium of the adult *Chimæra* projects ventro-anteriorly, and from the level of the foramen magnum to the level of the fenestræ nasales it is slightly curved, the hollow of the curve presented ventro-posteriorly. Anterior to the level of the fenestræ nasales, the mid-ventral line changes abruptly in direction, running at first dorso-anteriorly and then ventro-anteriorly and ending at the anterior end of the short beak-like process of the chondrocranium. This latter process is morphologically subnasal in position, as will be later explained, but as it has the appearance, in lateral view, of being prenasal, it may be called the prenasal process.

Beginning at about the level of the middle of the orbit and extending forward to its anterior edge, there is a median, longitudinal, gash-like groove which lodges the degenerated tissues of the extracranial portion of the hypophysis, the groove being deepest at its posterior end and gradually vanishing anteriorly. This groove represents a persisting remnant of the hypophysial fenestra, that fenestra being, in the adult, completely closed toward the cranial cavity, as it apparently was even in the chondrocranium of the sixth-month embryo shown by Dean. Starting lateral to this groove, on either side, a pronounced but low and rounded ridge runs antero-laterally to the level of the ventral end of the antorbital wall, where it turns somewhat abruptly antero-ventrally and but slightly laterally and bears on its end an articular facet and an articular head, the former lying directly mesial to the latter and both surfaces giving articulation to the mandibula. From the anterior edge of the articular facet the narrow ventro-lateral edge of the chondrocranium runs antero-mesially in a curved line, concave ventrally, till it reaches a point slightly anterior to the ventral edge of the fenestra nasalis, where it turns anteriorly and becomes the ventral edge of the beak-like prenasal process.

Between the mandibular articular facets of opposite sides, the ventral surface of the chondrocranium is deeply concave, this concavity lying in the ethmoidal region and being traversed by the raised median longitudinal ridge of the fused trabeculæ. Anterior to this large subethmoidal depression there is a smaller, subnasal one which lies in the hollow of the beak-like prenasal process, the two depressions being separated by a **V**-shaped ridge, each arm of the V running antero-laterally from the projecting ventro-posterior corner of the subethmoidal keel. The anterior dental plates lie against the dorsal wall of the anterior half of the subnasal depression, the posterior dental plates lying against the anterior border of the subethmoidal depression. From the bottom of the posterior half of the subnasal depression a tough pad of tissue arises and projecting ventrally fills the space between the dental plates.

The bottom of the large subethmoidal depression is separated by the raised ridge of the fused trabeculæ into two parts, each triangular in shape, and as each depression lies beneath the lateral portion of the ethmoidal cartilage it may be called the ectethmoidal depression, the two ectethmoidal depressions forming the large subethmoidal one. Each ectethmoidal depression is traversed by the nasal vein of its side, this vein, in some specimens, lying in a pronounced groove at the bottom of the depression. This vein comes from the nasal capsule and the regions anterior to it, and is directly continuous, in the nasal capsule, with a vein that enters the cavum cranii, accompanying the nervus olfactorius, and joins a vein that issues from the cranial cavity through the foramen for the nervus vagus. The nasal vein, running posteriorly from the nasal capsule, first traverses a canal that leads from that capsule through the anterior wall of the ectethmoidal depression, then receives a branch that has traversed the overlying cartilage through a small foramen, and then itself traverses a foramen in the posterior wall of the ectethmoidal depression to enter the orbit and fall into the orbital venous sinus. The ectethmoidal depression of this fish thus corresponds, in general position and in its relations to the nasal vein, to the ectethmoidal chamber of my descriptions of *Chlamydoselachus* (Allis, 1913), that chamber being, in certain of the Selachii, an open fossa which may, as in *Heptanchus*, be in direct communication with the cranial cavity through the basal communicating canal of Gegenbauer's descriptions. There is, in *Chimæra*, no indication of this latter canal, but it is perhaps worthy of note that in *Lepidosiren* there is, in just this region, a median perforation of the basis cranii (Bridge, 1898).

At the postero-mesial corner of the ectethmoidal depression of *Chimæra*, near the summit of the ridge that there bounds the depression, there is a groove which leads postero-mesially to a canal which traverses the cartilage of the basis cranii and transmits the efferent pseudobranchial, or so-called anterior carotid artery, this canal opening on the dorsal surface of the cartilage in the region of the line of attachment of the membranous interorbital wall, and directly ventro-lateral to the foramen by which the nervus opticus traverses that membranous wall.

The foramen opticum lies directly dorsal to a well-marked and rounded transverse ridge on the floor of the cranial cavity, this ridge marking the anterior end of the pituitary fossa and hence being the presphenoid bolster of my descriptions of the Selachii. The cranial cavity is here abruptly constricted, latero-mesially, and this constriction, in its ventral portion, is produced by the pinching in of the mesial membranous walls of the orbits, the membrane of either orbit being pinched inward and downward so that the internal surface of its ventral portion lies closely upon the cartilage of the basis cranii. The membrane there usually, but not always, becomes adherent to the cartilage, and a second line of attachment of the membranous cranial wall, lying mesial to the primitive line, is acquired. A depression is thus formed in the ventral portion of the outer surface of the membranous wall of each orbit, and it is filled with tough fatty connective tissue. The original line of attachment of the membranous wall forms the ventro lateral edge of this depression, and lies lateral to the foramen for the efferent pseudobranchial artery, while the secondary line of attachment lies mesial to that foramen, the membrane covering the foramen. Having issued from its foramen, the efferent pseudobranchial artery runs posteriorly beneath the covering membrane and issues in the cranial cavity at the base of the posterior wall of the depression, there lying posterior to the nervus opticus. It then immediately gives off a recurrent branch which perforates the posterior wall of the depression, traverses the tough fatty tissue that fills the depression, and, joining the nervus opticus, accompanies that nerve to the eyeball. After giving off this branch, the pseudobranchial artery turns mesially and immediately separates into anterior and posterior cerebral arteries.

When the secondary attachment of the membranous orbital wall to the dorsal surface of the basis cranii is not strong, the pseudobranchial foramen opens directly into the cranial cavity, but when the attachment is strong it opens external to that cavity but beneath the covering membrane. The nervus opticus, after issuing from its foramen, lies directly upon this adherent membrane, and the membrane may there become thinned to such an extent that, in dissections not carefully made, the pseudobranchial foramen appears as a perforation of the suborbital shelf lying wholly external to the interorbital wall; this apparently having been the condition in the specimen examined in connection with my earlier work on the arteries of this fish (Allis, 1912), where the foramen is said to open external to the cranial wall. The foramen however lies, morphologically, in the actual floor of the cranial cavity, as it is shown in Schauinsland's figure of an embryo of *Callorhynchus*. In the Selachii this foramen always lies, in all the specimens that I have examined, dorsal to the trabeculæ, and where there is a suborbital shelf it lies dorsal to that shelf. This foramen of *Chimæra*, which is quite unquestionably the homologue of the foramen in the Selachii, must then have become surrounded by and quite deeply enclosed in the dorso-lateral edge of the trabecula, the membranous lateral wall of this part of the neurocranium thus lying lateral to it and the foramen appearing to lie in the floor of the cranial cavity. The foramen is not shown in Dean's figure of an embryo of *Chimæra*, doubtless because it is hidden, in dorsal view, by the supraorbital portion of the cranial wall.

The branch of the pseudobranchial artery that accompanies the nervus opticus to the eyeball was called by me, in the earlier work just above referred to, the arteria ophthalmica magna, this identification of the artery being based on its apparent origin, in a dissection in which the tissues had evidently been torn, from the pseudobranchial artery before that artery enters the cranial cavity. This is, however, an error, the artery quite certainly being the arteria centralis retinæ, or optic artery, of my descriptions of the Selachii, and no arteria ophthalmica magna being found in this fish.

At the hind end of the orbit five foramina, lying close together, perforate the cranial wall and transmit the nervi profundus, trigeminus, buccalis lateralis, facialis, and abducens. The foramen for the facialis is always separated from the other foramina by cartilage, and the foramen for the abducens usually so separated, the other three nerves usually issuing through a single foramen but being separated from each other by membrane. Dorsal to these foramina there is a large foramen for the ramus ophthalmicus superficialis*, and two foramina that lie near the edge of the membranous mesial wall of the orbit, one of them transmitting the nervus trochlearis and the other a venous vessel which is doubtless the anterior cerebral vein of my descriptions of *Amia* and the Teleostei. Slightly anterior to the five foramina that transmit the trigeminus, facialis, and abducens nerves there is the foramen for the nervus oculomotorius, which lies at the edge of the membranous mesial wall of the orbit, and ventrolateral to that foramen there is a small foramen for the pituitary vein, this latter foramen opening into the pituitary fossa. The vein that traverses this latter foramen is small, and although it connects with its fellow of the opposite side in the usual piscine manner, it is always in communication with a vein that issues from the cranial cavity through the foramen for the nervus vagus. There is in this fish no transverse pituitary canal such as is found in many of the Selachii.

Lateral to the several foramina above described, there is a large perforation of the suborbital shelf which transmits the ramus hyoideo-mandibularis facialis and the vena jugularis, and anterior to that foramen there is another perforation of the shelf which transmits the arteria carotis externa and the ramus palatinus facialis, these two foramina being persisting remnants of the palatoquadrate fissure of Dean's (1906, p. 108) descriptions of embryos. That fissure of embryos lies, as shown in Dean's figures, between the palatoquadrate, the trabecula, and the anterior edge of a shelf of cartilage that projects laterally from the neurocranium beneath the hind end of the orbit and is fused, in its antero-lateral portion, with the palatoquadrate. The vena jugularis accordingly lies definitely ventral to this laterally projecting shelf like process of the neurocranium, and hence also morphologically ventral and internal to the dorso-posterior portion of the palatoquadrate. If then this shelf-like process is an outgrowth of the neurocranium, the dorso-posterior end of the palatoquadrate, as shown by Dean, must be the processus oticus of that cartilage, but it seems much more probable that the shelf itself is the processus oticus, or extra-branchial element of the arch. Dean (*l. c.* p. 129) considers this shelf to be the posterior portion of the pharyngeal element of the mandibular arch, but in that case this element of the arch has fused with the neurocranium dorsal to the vena jugularis, which would be in marked exception to the conditions found in all other fishes that I know of (Allis, 1915). It accordingly seems to me, as above stated, that this shelf must represent the extrabranchial of the arch, or processus oticus quadrati, apparently found only partially fused with the palatoquadrate in Dean's six-month embryo. The vena jugularis, ramus hyoideo-mandibularis facialis, and arteria carotis externa would then all lie ventral and internal to this element of the arch, as they normally should, and the foramina for these several structures would represent the trigemino-facialis chamber of the fish, as I have already suggested in an earlier work (Allis, 1914).

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* A small foramen is, by error, shown in figure 3, Plate II., lying slightly ventral to this large foramen. It does not exist in the fish.

The orbit has postorbital and antorbital processes. The postorbital process is a pronounced and slightly curved ridge which is fused ventrally with the suborbital shelf. The dorso-lateral antorbital process is a short but tall ridge which lies at the dorso-anterior edge of the orbit, and its base is perforated by a foramen which transmits the ramus ophthalmicus superficialis trigemini from the orbit to the ethmoidal canal. Immediately ventral to this process there is a foramen which transmits a vein and artery, and antero-ventral to this latter foramen there is another foramen which transmits the nervus ophthalmicus profundus; both these foramina leading into the median ethmoidal canal. A small foramen dorsal to these foramina also leads into the ethmoidal canal and gives exit to a small branch of the ophthalmicus superficialis. A small foramen on the dorso-mesial surface of the nasal capsule gives passage to a branch of the orbital branch of the external carotid, and anterior to it there is another small foramen for a delicate branch of the ophthalmicus nerve. The ventro-lateral antorbital process is simply a ridge which traverses the suborbital shelf and is continued onto the palatoquadrate, where it turns posteriorly and joins the ventral end of the postorbital process, this ridge forming the boundary between the horizontal portion of the suborbital shelf and its ventrally projecting eaves-like lateral edge. Between its dorso-lateral and ventro-lateral processes the remainder of the antorbital process is a wide and gently rounded surface which extends from the orbit to the nasal capsule, and is so completely fused ventrally with the dorsal edge of the palatoquadrate that even the line separating the two cartilages cannot be recognised.

The suborbital shelf is a wide thin plate of cartilage which extends between the antorbital and postorbital processes, and has a narrow, ventrally projecting, eaves-like lateral edge, just above referred to. The shelf is prolonged posteriorly beyond the postorbital process, this postorbital portion of the shelf projecting ventro-posteriorly at a slight angle to the orbital portion, and apparently representing, as just above explained, the processus oticus quadrati. It gives origin, on its ventral surface, to the musculus protractor arcuum branchialium of Vetter's (1878) descriptions. On the ventral surface of the continuous shelf these two portions are separated from each other by a groove which lies directly ventral to the ventral end of the postorbital process and is directed postero-mesially. That part of the orbital portion of the shelf that lies lateral to the foramen for the nervus hyoideo-mandibularis facialis belongs to the palatoquadrate, and is probably formed by the epal (quadrate) and pharyngeal portions of the mandibular branchial bar, the pharyngeal element not projecting as a processus basilaris.

The cranial cavity has large anterior and posterior portions, separated by a narrow neck in the orbital region, this neck lying between the ventral edge of the azygous portion of the membranous interorbital wall and the summit of the rounded transverse presphenoid bolster. The posterior portion of the cavity is tall, with a concave anterior edge the dorsal end of which projects dorso-anteriorly above the orbit like the horn of a crescent. The postclinoid wall lies at about the middle of the length of this posterior portion of the cavity and projects anteriorly or antero-dorsally. Between it and the foramen magnum there is a depression in the cranial floor, and anterior to it, between it and the presphenoid bolster, is the large pituitary fossa. The postero-dorsal end of the hypophysial groove on the ventral surface of the basis cranii lies slightly posterior to the summit of the presphenoid bolster. A slight transverse ridge at about the posterior quarter of the pituitary fossa marks off a small posterior and deeper portion of the fossa. The foramina for the nervi facialis, trigeminus, and abducens lie dorsal or postero-dorsal to the postclinoid wall, and the small foramen for the pituitary vein antero-ventral to it.

The anterior portion of the cranial cavity increases gradually in height from its hind end up to the base of the median rostral process, that point marking also the anterior end of the ethmoidal canal. This latter canal is large and is separated from the cranial cavity by cartilage slightly thinner than that of the basis cranii. Beyond the anterior end of the ethmoidal canal the cranial cavity contracts somewhat abruptly to its anterior end, that end being marked, on either side, by the foramen olfactorium. The cranial cavity of the adult accordingly shows, when compared with Dean's figures of embryos of this fish and with Schauinsland's figures of embryos of *Callorhynchus*, that the dorsal portion of the chondrocranium has undergone marked lateral compression in post-embryonic stages, the membranous mesial walls of the orbits being pressed together so that they meet and coalesce in the median plane in front of the midbrain and dorsal to the forebrain, a considerable portion of the cranial cavity of embryos thus being obliterated. Because of this, or correlated to it, the midbrain becomes, in the adult, widely separated from the hind end of the ethmoidal canal, and the forebrain is correspondingly elongated.

The two foramina olfactoria are separated from each other by a stout column of cartilage which lies nearly at right angles to the cranial floor, and each foramen is closed by a membranous cribriform plate. Each foramen opens directly into the mesial portion of the posterior end of the related nasal capsule, that capsule being directed antero ventrally and bulging laterally so that it forms a pronounced swelling on the lateral surface of the chondrocranium. The ventral edge of the capsule reaches nearly, but not quite, to the ventral edge of this part of the chondrocranium, and the capsules of opposite sides are in contact in the median line, a septum nasi separating them from each other. This septum nasi is continuous, posteriorly, with the column of cartilage that separates the foramina olfactoria, that column lying in large part posterior to the plane of the foramina and representing the rostral stalk of embryos of *Callorhynchus* and of the Selachii. The septum nasi thus lies morphologically ventral to the stalk, and is formed either by a subethmoidal keel alone, or by that keel fused with the contiguous mesial sides of the nasal capsules, the rostral stalk forming the morphologically dorsal edge of the septum, as it also does in *Mustelus* (Gegenbaur, 1872, fig. 1, pl. 5) and *Scyllium* (Parker, 1876, fig. 4, pl. 37). The nasal capsules thus fuse with each other, in *Chimæra*, ventral to the trabeculæ, as they do in the Selachii, this confirming the conclusion already arrived at that they have this position in *Callorhynchus*.

With the contact and fusion of the nasal capsules in the median line ventral to the trabeculæ, the ventro-lateral trabecular processes of opposite sides, if they existed in this fish, must also have been pressed together in the median plane, and their flaring ventral ends probably form some part of the beak-like prenasal process, that process being, as already stated, morphologically subnasal, instead of prenasal in position. The palatine processes of the palatoquadrate must, however, also take some important part in the formation of this beak, for the anterior dental plates, which it supports, lying as they do posterior to the primary upper lips (Allis, 1917 *b*), must belong to the primary, or palatoquadrate dental arcade. These plates cannot accordingly be intermaxillary (premaxillary) teeth, as Schauinsland (1903, p. 14) suggests as possible in *Callorhynchus*, and they must be either vomerine or vomero-palatine teeth according as the term palatine is used to apply to teeth developed in relation to the palatine process of the palatoquadrate or in relation to some part of the palatoquadrate that lies posterior to that process. The posterior dental plate of either side would then be either a pterygoid or a palato-pterygoid plate, a pterygoid element quite certainly being included in it. Further facts in favour of considering the beak of *Chimæra* to be formed in part by the palatine process of either side are: -

1. That the external surface of the prenasal beak gives articulation to the anterior end of a cartilage that is quite unquestionably an anterior upper labial, as will later be explained, and this anterior end of this labial is frequently, in the Selachii, in contact with the dorsal surface of the palatoquadrate but never in such contact with the neurocranium, as is also later explained.

2. That the beak of *Chimæra* is traversed, on either side, by a small canal which, in the specimen used for illustration, begins on its dorsal surface by a single foramen and opens on its ventral surface by three small foramina which lie internal to the anterior dental plate. This canal is traversed by a branch of the nervus maxillaris trigemini which descends over the lateral edge of the nasal capsule and is evidently destined to innervate the anterior dental plate and the related tissues. The corresponding nerve in *Mustelus*, *Chlamydoselachus*, and *Raia*, and hence probably in all of the Plagiostomi, runs forward along the external surface of the palatoquadrate and then over its ventro-lateral edge, thus being separated from the trabeculæ by the full width of the palatoquadrate, and while it might become enclosed in the lateral edge of the palatoquadrate it seems impossible that it could become so enclosed in the lateral edge of any cartilage of trabecular origin.

The mandibula presents no special features that seem to require consideration, but it may be mentioned that there are two surfaces for the articulation with the palatoquadrate, the antero-lateral one being an articular facet and the postero-mesial one an articular head. It is also to be noted that the line of the gape of the jaws, when the mouth is closed, is approximately parallel with the line of the trabeculæ, the plane of the epal and ceratal elements of the mandibular arch thus retaining its primitive perpendicular relations to the trabeculæ and hence being directed postero-ventrally instead of ventrally.

2. *Nasal and Labial Cartilages.*

The so-called nasal and labial cartilages of current descriptions of the Holocephali are much more numerous than the similarly named cartilages of the Selachii, and the conditions in the latter fishes must first be considered.

The nasal cartilages of the Selachii are limited to the ala nasalis (Nasenflügelknorpel), and this cartilage I have recently described in a certain number of these fishes and compared it with the cartilage in *Chimæra* (Allis, 1917 *b*). It is accordingly not necessary to here consider it in the former fishes.

The labial cartilages of the Selachii are limited to one or two related to the upper jaw and one related to the lower jaw. Gegenbaur (1872) called the one or two former cartilages the anterior and posterior upper labials, and as he at that time considered the premaxillary and maxillary bones, respectively, of the Teleostei to be developed superficial to, and in relation to, these cartilages, he also called them the premaxillary and maxillary labials. These latter terms I shall avoid because of the implied homologies, which I consider not yet established. The single labial related to the lower jaw Gegenbaur called the lower, or premandibular labial, the latter term being used by him because he then considered this labial and the maxillary labial to together represent persisting remnants of a premandibular visceral arch. This latter term I shall also avoid, using in its place the indifferent term mandibular labial. If it should be later established that this labial and one or both of the upper labials are structures related to a premandibular arch or arches, they can then be given names that will show their relations to the arch or arches to which they belong.

The hind end of the mandibular labial and the corresponding end of one or both of the upper labials articulate with each other, or are connected by ligament, immediately posterior to the outer end of the line of the angle of the gape, and these ends of the labials there lie at a certain distance from the cartilages of the upper and lower jaws, separated from them by the thickness of the anterior edge of the musculus adductor mandibulæ. This point of articulation of the labials lies at a variable distance anterior to the quadrato-mandibular articulation, and it is shown in nearly all of Gegenbaur's figures of these fishes lying external to the mandibula.

In *Chlamydoselachus* there are two upper and one lower labials, and they have been described or figured by Goodey (1910), K. Furbringer (1903), and Luther (1909 *a*). The anterior labial gives attachment, along the dorsal edge of its anterior end, to a ligament which has its origin on the anterior wall of the orbit at about the middle of its height. Numerous short ligamentous strings run from the antero-ventral edge of this ligament into the tissues of the upper lip, this seeming to indicate that the ligament has been differentiated from an extensive dermal or subdermal fascia. The posterior upper labial lies internal and aboral to the anterior one and is closely attached to the musculus levator labii superioris, the tendon of that muscle passing ventral to the ligament related to the anterior labial and having its insertion on the ventro-lateral antorbital process.

In a specimen that I have of *Mustelus*, probably *vulgaris*, there are two upper labials, and they are strikingly similar to those shown by Gegenbaur in a figure (1872, fig. 3, pl. 11) said, in the explanations of the plates, to be of *Mustelus*, but referred to in the text as of *Galeus*. In this figure the jaws are furnished with sharp pointed teeth; and Marshall and Spencer (1881) and Ridewood (1895) have each independently called attention to the fact that, because of these teeth, the figure is probably of *Galeus*, as it is said by Gegenbaur to be in his text. But, curiously enough, in this figure with sharp teeth, and hence probably of *Galeus*, there are two upper labials similar to those I find in my specimen of *Mustelus*, identified by the presence of pavement teeth, while in the figure said by Gegenbaur (*l. c.* fig. 2, pl. 12) to be of *Galeus*, but furnished with pavement teeth and hence probably of *Mustelus*, there is but one labial. Gegenbaur furthermore says (*l. c.* p. 214) that both Meckel and J. Müller also found but one upper labial in *Mustelus*; but K. Fürbringer (1903) has since found two of them in *Mustelus equestris*. If these labials do not vary in different specimens or species of *Mustelus*, it is thus probable that Gegenbaur, in his figures above referred to, interchanged either the labials or the teeth, as well as the names, of the two fishes.

But, whatever the error in these two figures of Gegenbaur's may be, in my specimen, which has pavement teeth, there are two upper labial cartilages, and they both lie in the maxillary portion of the labial fold. The anterior labial is about twice as long and much stouter than the posterior one, and lies external and oral to it, as does the anterior labial in *Chlamydoselachus*. Its hind end lies but slightly anterior to the hind end of the posterior upper labial and is attached to that labial, but not to the mandibular one, by ligamentous tissues. The anterior half, approximately, of the anterior labial lies internal to the ventral edge of the musculus levator labii superioris, in a pocket formed in the tough connective tissues that cover the external surface of the palatoquadrate. The labial is freely movable in this pocket, and its anterior end lies directly upon the palatoquadrate, in a scarcely perceptible depression in that cartilage, but is in no way attached either to it or to the chondrocranium. The walls of the pocket are differentiations of a dermal or subdermal fascia which is somewhat ligamentous in character, and which extends antero-mesially and is attached to the posterior surface of the nasal capsule; this fascia doubtless representing the one from which the ligament attached to this labial in *Chlamydoselachus* is developed.

The posterior upper labial of *Mustelus* is bound by ligamentous tissues to the mandibular labial, and can thus be said to articulate with it. From near its hind end a ligamentous strand runs antero-dorsally and joins a stouter ligament which arises from the median transverse aponeurosis of the musculus adductor mandibulæ, at the inner end of the line of the angle of the gape. The ligament so formed is joined by a ligamentous slip from about the middle of the anterior labial, and then joins and fuses in part with the internal surface of the dorsal, maxillary portion of the adductor muscle and in part with the closely related musculus levator labii superioris. A part of the ligament continues forward and is inserted on the posterior surface of the nasal capsule at the lateral edge of the large surface of insertion, on that capsule, of a part of the musculus levator labii superioris. There are thus, in this fish, two ligamentous structures connecting the upper labials with the nasal capsule. In *Chlamydoselachus* this connection is, as just above stated, with the antorbital wall.

In *Triakis fasciatum* there are two upper labials, and they closely resemble, in relative size and arrangement, those in *Mustelus*. The hind ends of the two labials lie close together, and both are bound by ligamentous tissues to the hind end of the mandibular labial, but the posterior upper labial alone articulates with that labial. The anterior end of the anterior upper labial rests directly upon the external surface of the palatoquadrate, as in *Mustelus*, but it is not enclosed in a pocket of the connective tissues of the region. A broad stout ligamentous band arises from the external surface of the palatoquadrate, at its oral edge and slightly anterior to the angle of the gape, and running antero-mesially across the external surface of the anterior upper labial is inserted on the internal surface of the nasal latero-sensory canal, close to the posteromesial edge of the nasal capsule.

In two small specimens of *Scyllium canicula* I find, as Gegenbaur did, but one labial, and it quite certainly corresponds to the anterior upper labial of *Mustelus*, as Gegenbaur concluded. It extends forward along the ventral edge of, or slightly internal to, the musculus levator labii superioris, and its anterior end lies, as does that of the anterior upper labial of *Mustelus*, directly upon the external surface of the palatoquadrate, in a slight depression in that cartilage, but it is not enclosed in a pocket of connective tissue. This end of the labial lies directly internal to the posterior portions of the nasal and rostral sections of the latero sensory canals. In one of the two specimens, but not in the other, the mandibular labial hooked around the angle of the gape, as Luther (1909 *a*) shows it in his figure of *Chiloscyllium*, this suggesting the possible fusion of a much reduced posterior upper labial with the mandibular labial.

The anterior end of the anterior upper labial is thus, in each of these few Selachii, either in contact with or closely related to the dorsal surface of the palatoquadrate, and it is also either attached to, or related to, ligamentous or fibrous tissues which are attached to the chondocranium in the nasal region; and these are probably universal conditions in these fishes.

In *Chimæra* Hubrecht (1877) describes five cartilages that are called by him nasal cartilages, and four that are called labials, the nasal cartilages being designated by the letters *f*, *g*, *k*, *l*, *m*, and the labial cartilages by the letters *a*, *c*, *d*, *e*. The letter *n* is used by Hubrecht to designate a process of the cartilage *k*, this cartilage accordingly sometimes being referred to as the cartilage *kn*.

The cartilage *k*, with its large process *n*, is called by Hubrecht the Nasenmuschel, and as it certainly represents some part of the ala nasalis of the Plagiostomi, it may be referred to as that cartilage. It encircles the antero mesial or so-called ingress nasal aperture, and I have recently fully described it in this fish (Allis, 1917 *b*).

The cartilage *l*, shown in figure 4 (Pl. II.), is a small and irregular plate of cartilage which lies in the mucous tissues along the lateral edge of the process *n* of the ala nasalis, and it extends from that process to the inner surface of the cartilage *fg*. It bounds the dorso-mesial edge of the postero-lateral nasal aperture, and is attached both to the process *n* and the cartilage *fg* by connective or fibrous tissues, its point of attachment to the latter cartilage lying immediately beyond the base of the nasal fold process of that cartilage, to be described immediately below.

The cartilage *m* is a thin, flat, curved, triangular cartilage which is attached by its pointed mesial end to the dorso-mesial surface of the ala nasalis (cartilage *kn*) near its external edge, and from there extends ventro-latero-posteriorly in the nasal portion of the naso-labial fold. A small nodule of cartilage may be found attached to its latero posterior edge.

The cartilages *f* and *g*, said by Hubrecht to be found separate in *Callorhynchus*, are fused in *Chimæra*, to form a single piece called by Hubrecht both a Lippenknorpeltrager and a Nasenflugelknorpel. The two parts *f* and *g* differ slightly in coloration and appearance suggesting that they are of independent origin, the part *g* being a flat plate-like superficial cartilage, and the part *f* a stout rounded and curved rod, which arises from the ventro-posterior end of the plate-like portion of the cartilage and may be called the pedicel of the entire cartilage. The plate-like portion of the cartilage lies, in the posterior half of its length, in a nearly horizontal position along the outer edge of the nasal capsule. Its dorso anterior half turns dorso-anteriorly across the outer edge of the nasal capsule, and there lies on the outer surface of that capsule, passing latero-posterior to the lateral rostral process and being strongly but flexibly attached to that process by ligamentous tissues. Approximately at the point where the process turns dorso anteriorly, there is a prominent eminence on its internal surface, and this eminence rests upon the little eminence on the dorsal surface of the ala nasalis (cartilage *kn*) that is described in my earlier work (Allis, 1917 *b*), the two cartilages there being strongly but flexibly attached to each other by connective or ligamentous tissues. The pedicel of the cartilage turns sharply mesially, in a rounded angle, and passing through a notch in the postero-ventro lateral edge of the nasal capsule runs along the postero lateral edge of the postero lateral nasal aperture and reaches a small perforation of the chondrocranium that lies immediately ventral to the ventro posterior edge of the fenestra nasalis. This perforation of the chondrocranium is filled with ligamentous tissues, and to these tissues the foot of the pedicel is strongly but flexibly attached, the position of this pedicel strongly resembling that of the anterior upper labial in *Heterodontus* (Allis, 1917 *b*).

On the ventral edge of the cartilage *fg*, at about the posterior third of the length of its plate like portion, there is a slender curved process which projects ventrally into a ridge on the internal surface of the nasal portion of the naso-labial fold, this ridge quite certainly representing the tissues that enclose the process β of the ala nasalis of the Plagiostomi (Allis, 1917 *b*). Because of its position, this process of the cartilage *fg* may be called the nasal fold process. It is thinner than the body of the cartilage *fg*, is flexible, and in many instances seems to be a primarily independent piece of cartilage that has secondarily and not completely fused with the cartilage *fg*. In several instances there was a foramen between the base of this process and the body of the cartilage, this foramen giving passage to a delicate nerve which was apparently a branch of the nervus maxillaris trigemini. In other specimens this nerve passed between the process and a crescentic cartilage described immediately below. The cartilage *l* is attached to the inner surface of the cartilage *fg* immediately beyond the base of this nasal fold process.

In the hollow of the curve formed by the posterior edge of the nasal-fold process of the cartilage *fg* and the ventro-posterior portion of the body of that cartilage, lies the crescentic piece of cartilage just above referred to. This cartilage is of the same consistence as the nasal-fold process, and lies, as that process does, in the ridge on the internal surface of the naso-labial fold, and it is apparently the cartilage *e* of Hubrecht's descriptions of *Chimæra monstrosa*. Both it and the nasal fold process of the cartilage *fg* are shown in one of Luther's figures of the latter fish (1909 *b*, p. 37), and K. Fürbringer (1903) also refers to both of them, the two together being considered by him to represent the cartilage *e* of Hubrecht's descriptions. In *Chimæra colliei* the crescentic cartilage is connected with the cartilage *d*, which I consider to be the posterior upper labial, by a band of tough fibrous tissue which passes across the external surface of the cartilage *fg*, a slip of the tissues being sent antero-dorsally along the external surface of the latter cartilage. This crescentic cartilage and the nasal-fold process of the cartilage *fg* thus seem to both be chondrifications of this fibrous tissue, one of them related to the cartilage *d* (posterior upper labial) and the other to the cartilage *fg*.

The cartilage *fg* is thus a strongly curved cartilage which encircles the lateral half of the fenestra nasalis, lying against the external, and not the internal, surface of the edge of the fenestra, and it either sends a process into the ridge on the internal surface of the naso labial fold, or becomes secondarily fused with a cartilage that is developed independently in that ridge. The lining membrane of the nasal capsule is not attached to this cartilage *fg*, as it is to the cartilage *kn* (ala nasalis), lying wholly internal to it. The cartilage is capable of a swinging, dorso-ventral motion around a line passing through its two points of attachment to the chondrocranium, the cartilage passing backward and forward across the outer, and not the inner, surface of the lateral edge of the fenestra nasalis. The posterior one of these two motions is impressed upon it by the musculus levator anguli oris anterior of Vetter's (1878) descriptions, acting both through its own tendon and the long and slender ligament called by Luther (1909 *b*) the levator cartilaginis prælabialis, the contrary motion apparently being caused in part by the simple elasticity of the parts, and in part by the action of the musculus labialis posterior. The musculus labialis anterior, which is attached by one end to the dorso anterior end of this cartilage and by the other to the cartilage *d* (posterior upper labial), would seem to exert its action on the latter rather than on the former cartilage.

Hubrecht says that the process *α* of Gegenbaur's descriptions of the Selachii, together with that part of the edge of the nasal capsule that, in those fishes, bounds the mesial edge of the postero-mesial nasal aperture, corresponds to the cartilage *kn* of *Chimæra*, this latter cartilage thus being considered by him to be cut off from the outer edge of the nasal capsule, and its process *n* to correspond to the process *α* of the Selachii. The cartilage *fg* of *Chimæra* is said to correspond to the process *β* of Gegenbaur's descriptions of the Selachii, the cartilage *e* of *Chimæra* to represent the anterior upper labial of the Selachii, and the cartilage *l* to be a remnant of that part of the ala nasalis that primarily connected the cartilages *kn* and *fg*.

Both Furbringer (1903) and Luther (1909 *b*) apparently accept Hubrecht's conclusions regarding the homologies of these several cartilages of *Chimæra*; but Luther nevertheless calls the cartilage *fg* a premaxillary cartilage, which must mean that he considers it to be a labial and not a Nasenflügelknorpel, and he neither mentions, nor shows in his figures, the cartilage *e*. Vetter (1878), who knew of Hubrecht's work only by title, describes as a premaxillary cartilage a cartilage that must be the cartilage *fg* of Hubrecht's descriptions, but he makes no mention of the cartilage *e*. He shows, in one of his figures, a so-called Nasenflugelknorpel, which is said to be longer than the premaxillary cartilage, to lie directly mesial to it, and to be derived from the nasal capsule. This cartilage, as shown in Vetter's figure, is not found in *Chimæra colliei*, and it is not shown in Hubrecht's figures of *Chimæra monstrosa*. Its dorsal end corresponds, in position, to the lateral rostral process of these fishes, the remainder of it apparently being the cartilage *m* of Hubrecht's descriptions, or both that cartilage and the cartilage *kn*.

My conclusions regarding the homologies of these several cartilages differ somewhat from those of these several authors, and they are based on my interpretation of the lips and nasal apertures of this fish as set forth in the work already several times referred to as now in press (Allis, 1917 *b*), and which should here be consulted.

In the Plagiostomi it is always that part of the ala nasalis that encircles the antero lateral and ingress nasal aperture that is the most developed, the part that encircles the postero mesial and egress aperture always being less developed and in some cases wholly wanting. In *Chimæra*, on the contrary, it is the part of this cartilage that encircles the antero-mesial and here so-called ingress aperture that is the most developed, that part of the cartilage that encircles the antero-lateral and originally ingress aperture having undergone marked reduction. That part of the cartilage that encircles the antero-mesial aperture is represented in the cartilage *kn* of Hubrecht's descriptions, the cartilage *k* representing that part of the ala nasalis of the Plagiostomi that lies mesial to and between the processes *α* and *β* of Gegenbaur's (1872) descriptions of the latter fishes, and the process *n* of the cartilage *k* representing the process *α* of the Plagiostomi together with the process that Gegenbaur calls, in *Mustelus*, the process *α'*. The process *β* of the Plagiostomi is represented in *Chimæra* in the little crescentic cartilage that lies in the ridge on the internal surface of the naso-labial fold, and a remnant of that part of the ala nasalis that originally lay between this process and the process *α* is represented in the cartilage *l* of *Chimæra*.

The cartilages *m* and *q* of *Chimæra* have no homologues in the Plagiostomi, but they, the nasal-fold process of the cartilage *q*, and the little adjacent crescentic cartilage are all evidently of fibrous origin and all quite certainly chondrifications of a subepidermal layer of fibrous tissue. Just what this layer of tissue is I have been unable as yet to definitely determine, but it would seem to be the fibrous layer of the corium. The nasal flap cartilage of my descriptions of *Raia* (Allis, 1916) is certainly a chondrification of this same layer of tissue, and as the process *x* of the ala nasalis of that fish has exactly the same subepidermal position as the nasal-flap cartilage, that process must also be of fibrous origin. But, if this process *α* is of fibrous origin, the alar ring, of which it is a process, must also be of similar origin, all of these cartilages then being chondrifications of a single layer of subepidermal fibrous tissue. This fibrous layer certainly passed, originally, beneath the epidermal tissues that were modified to form the sensory epithelium of the nasal pit, and when this sensory tissue was invaginated to form that pit, the fibrous layer must have been invaginated with it. The nasal capsule might then itself also be a chondrification of this same layer of fibrous tissue, and hence not a part of the axial skeleton, as it is usually considered to be; and its development in the Plagiostomi is decidedly in favour of this assumption.

The cartilage *f* of Hubrecht's descriptions of *Chimæra*, although it lies along the edge of the postero lateral nasal aperture, has no relations whatever to the original antero lateral nasal aperture, and hence is not a derivative of the ala nasalis, and its position strongly indicates that it is an anterior upper labial. It has approximately the position of that labial in *Heterodontus*, and also that of the single labial of *Ceratodus* (Allis, 1917 *b*), and the fact that its anterior end is in contact with a part of the chondrocranium that is quite unquestionably derived from the palato-quadrate is in accord with the conditions that I have above described in several of the Selachii, and would be wholly exceptional for a cartilage derived from the ala nasalis. If, in one of the Selachii above referred to, the fibrous or ligamentous tissues that are related to the anterior upper labial, and that are attached to the chondrocranium in the nasal region, were to undergo chondrification, a cartilage would arise that would closely resemble the cartilage *fg* of *Chimæra*, one part of this cartilage thus being of labial origin and the other of independent fibrous origin. Furthermore, this origin of the cartilage is in accord with its relations to the terminal branches of the nervus maxillaris trigemini, for the more important terminal branches of that nerve pass internal to the cartilage, between it and the nasal capsule, which is not their relations either to any part of the nasal capsule of the Selachii or to the ala nasalis of those fishes, but is their relations to the anterior upper labial and its related ligaments in those fishes. What is apparently the cartilage *f* in Schauinsland's descriptions of embryos of *Callorhynchus* (1903, n^2, fig. 127) has, however, decidedly the appearance of being a part of the ala nasalis, but the cartilages as there shown are so different from those in the adult *Chimæra* that I am unable to make any comparison. Two of the cartilages described by Schauinsland, called by him the cartilages l^1 and l^2, are said by him to lie in mucous folds "welche die Schnauze umgeben" and to represent preoral visceral arches. Premandibular arches they may represent, as may also the labial cartilages of the Selachii, but they certainly cannot represent preoral arches.

The cartilages *c* and *d* of Hubrecht's descriptions were considered by him to together represent the posterior upper labial of the Selachii. They are first said by him to be separate and distinct cartilages, capable of a slight motion with each other, but they are later said to be so completely fused that there is even but slight persisting indication of the line of separation between them. Vetter found them as separate cartilages and considered them to be, respectively, the maxillary and mandibular labials. K. Fürbringer found them more independent of each other than they are said to be by Hubrecht, but less so than described and figured by Vetter, and he agrees with Hubrecht in considering them, together, to represent the posterior upper labial. Luther shows them as a single cartilage, and they together form the maxillary, and hence posterior upper labial of his descriptions. I find them as separate and distinct cartilages lying immediately posterior to the angle of the supplementary secondary gape of the mouth and straddling the line prolonged of that angle, that angle lying near the inner end of the line of the angle of the gape, as fully described in my work now in press (Allis, 1917 *b*). One of these cartilages thus lies dorsal and the other ventral to the line of the angle of the gape, in the positions respectively of the posterior upper and mandibular labials of the Selachii, and I accordingly consider them, as Vetter did, to represent, respectively, those labials, notwithstanding that they both, and particularly the posterior upper labial, seem to be chondrifications of the same fibrous layer that has given origin to the cartilages *g*, *m*, and *e* of Hubrecht's descriptions.

The posterior upper labial, thus identified, is a small and somewhat rectangular cartilage that lies immediately dorsal (morphologically posterior) to the ventro-posterior-lateral end of the plate like portion of the cartilage *fg*. It is strongly but loosely attached, by its ventral (morphologically anterior) end, to the latter cartilage, and also strongly but quite rigidly attached, by the adjoining, posterior (morphologically ventral) edge, to the dorsal end of the mandibular labial. This latter attachment allows of but little motion between the two pieces, such little motion as there is being latero-mesial. The labial gives insertion, on its dorsal (morphologically posterior) edge, to the musculus levator anguli oris anterior, and either on its external surface or its anterior (morphologically dorsal) edge, to the musculus labialis anterior, the other end of the latter muscle being inserted on the dorso-anterior end of the cartilage *fg*.

The mandibular labial (cartilage *e*) is a stout bar of cartilage with a large triangular process on its anterior edge near its ventral end. The anterior edge of its dorsal end is strongly attached to the posterior upper labial, as just above described. Its ventral end lies in the hind end of the labial part of the naso labial fold. Its anterior process passes internal to the hind end of the supramandibular furrow, and lies in supporting relations to the supplementary secondary lower lip, this process and the nasal-flap process of the cartilage *g*, together with the related crescentic cartilage above described, thus being opposed to each other in these supplementary secondary lower and upper lips. The anterior end of the anterior process of the mandibular labial gives insertion to a tendon of the musculus levator anguli oris posterior, that tendon passing downward across the internal surface of the labial to reach its point of insertion, as shown in Luther's figure of *Chimæra monstrosa*. Connected with this tendon, and as direct ventral continuations of it, there are two small ligaments, one of which joins the ligament *l* of Luther's descriptions, to be described immediately below, while the other runs ventromesially along the external surface of the mandibula, internal to the musculus labialis posterior, and has its insertion in tough fibrous tissues in the median line. The tendon of the musculus labialis posterior runs dorsally along the internal surface of the mandibular labial, internal (mesial) to the tendon of the musculus levator anguli oris posterior, and has its insertion on the internal surface of the mandibular labial near its dorsal end. this also being as shown in Luther's figures of *Chimæra monstrosa*.

The cartilage *a* of Hubrecht's descriptions was considered by him to be, together with a related "Bandapparat," the homologue of the mandibular labial of the Selachii. Vetter does not mention this cartilage. K. Fürbringer accepts Hubrecht's statements regarding it as correct. Luther considers this cartilage, alone, to be the homologue of the mandibular labial of the Selachii, and, following Gegenbaur's nomenclature, he calls it the premandibular labial. The Bandapparat he considers to be an independent and superficial structure, and he fully describes it in *Chimæra monstrosa*.

In *Chimæra colliei*, the thick lower lip contains a mass of dense tough fibrous tissue which extends the full length of the lip and from its oral edge a certain distance posteriorly. This mass of tissue completely surrounds the musculus labialis posterior, that muscle traversing a canal-like perforation of the posterior portion of the tissue without being in any way attached to it excepting only at its origin near the symphysis of the mandibles. The anterior (oral) end of the cartilage *a* is strongly attached to this tough fibrous tissue, and it abuts against the posterior surface of the musculus labialis posterior, the cartilage being grooved to receive the muscle and the edges of the groove sometimes projecting to such an extent that the cartilage is decidedly Y-shaped. External to the symphysial edge of the cartilage, and strongly attached to it, there is a small piece of strongly calcified cartilage which is grooved on its external surface to lodge a section of the mandibular latero-sensory canal. On its symphysial edge the cartilage *a* gives origin to ligamentous tissues which cross the median line and are attached to the corresponding cartilage of the opposite side; this apparently being as shown in Luther's figure of *Chimæra monstrosa*, but the musculus labialis inferior of that author's descriptions of *Chimæra monstrosa* is not found in my specimens of *Chimæra colliei*.

The ligament *l* of Luther's descriptions (1909 *b*, fig. 28) is found in my specimens of *Chimæra colliei* arising from the tough fibrous tissues that cover the ventral surface of the symphysis of the mandibles, and also from the external surface of the cartilage *a*. Running latero-posteriorly in a curved line, this ligament is joined first by a ligament coming from the median line posterior to the cartilage *a*, and then by a ligament coming from the ventral edge of the mandibular labial and to which reference has just above been made. The ligament so formed runs posteriorly across the postero-ventral edge of the mandibula, in a slight groove in that edge, and then runs upward along the internal surface first of the mandibula and then of the palatoquadrate, and is inserted on a little cartilage which seems to correspond to the spiracular cartilage of Hubrecht's descriptions of *Chimæra monstrosa*, notwithstanding that it lies much farther from the hind edge of the mandibula. This little cartilage is probably a persisting remnant of a mandibular branchial ray such as is frequently found in the Selachii and there currently called a spiracular cartilage, but it cannot be the homologue of the spiracular cartilage of the Batoidei, that cartilage being the extrabranchial, or suprapharyngobranchial, of the mandibular arch and being represented, in *Chimæra*, in the processus oticus quadrati, as already stated. The ligament related to this little cartilage may then represent either certain persisting fibrous tissues of the mandibular arch, or be a ligament derived from certain fibres of the primitive constrictor of the arch such as are found in *Astrape* (Luther, 1909 *a*, p. 14), and to which I have made reference in a work now in press on the homologies of the muscles related to the visceral arches in the gnathostome fishes (Allis, 1917 *a*). If this little cartilage be a persisting remnant of a mandibular branchial ray, then the cartilage *a* would also seem to be such a remnant. Luther (*l. c.* p. 46) considers the cartilage *a* to be a chondrification of the membrane in which it lies.

3. *Rostral Processes.*

The three rostral processes of the adults of all of the Chimæroids are said by Garman (1904) to be attached to the chondrocranium by ligaments "in such a way as to admit of considerable movement of their distal extremities up and down," the evident inference being that Garman did not find, in any of these fishes, the cartilage of these processes continuous with that of the chondrocranium. Hubrecht, however, shows all three of these processes directly continuous with the cartilage of the chondrocranium, and he suggests that the median process may be the homologue of the rostral process of the Selachii, and that the lateral processes are probably represented, in the latter fishes, by ligaments. Schauinsland (1903) refers to these processes, in embryos of *Callorhynchus*, as "mit dem Schadel fest verbundenen Knorpeln," and in his figures he shows all three of them as outgrowths of the septal cartilage of his descriptions and as directly continuous with it, the processes thus being of trabecular origin. Schauinsland says that these processes support the rostrum. Garman (1904, p. 252) says there is no rostrum in these fishes, but the presence of the rostral processes suggests that a rostrum existed in ancestral forms and has become obsolete. Gegenbaur (1898) says that the three rostral processes correspond to, but are not directly descended from, the three-limbed rostral basket of the Carchariidæ and Scylliidæ, this implying that they are directly continuous with the cartilage of the chondrocranium. Dean (1906) shows the median process directly continuous with the cranial cartilage in a six-month embryo of *Chimæra colliei*, but says (*l. c.* p. 129) that: "I am inclined to interpret it as an element, *i. e.*, a fin support, transposed from a hinder position," which would mean that it was not primarily a part of the cranial cartilage. The lateral rostral processes he says are "later developed into long and separately jointed elements." He considers the median bar of the rostral basket of the Carchariidæ and Scylliidæ to be probably represented in the septal plate of Schauinsland's descriptions of *Callorhynchus*, and hence not in the median rostral process of that author's descriptions. The lateral bars of the rostral basket of the Selachii are said to be possibly the homologues of the little processes *s* of Schauinsland's descriptions of *Callorhynchus*, to be later considered.

In my specimens of *Chimæra colliei*, I find the median rostral process articulating with and strongly bound by ligamentous tissue to, but not directly continuous with, a slight eminence of the chondrocranium that lies on its dorsal surface between the two anterior openings of the ethmoidal canal. The lateral process of either side arises from a thin and flexible portion of the anterior edge of the dorsal wall of the nasal capsule, and it is apparently directly continuous with the cartilage of that wall, the surfaces, when the process is removed, always appearing fractured. The median process runs at first dorso-anteriorly and then turns somewhat abruptly ventro-anteriorly, and extends approximately to the level of the outer ends of the lateral processes. From about the middle of the length of the proximal portion of the median process a ligament arises and runs antero-ventrally in the median line until it reaches the level of the lateral processes. There it spreads dorsally, ventrally and laterally and is lost in a layer of tough fibrous tissue that lies internal to the latero-sensory canals on the ventro-anterior surface of the snout, and forms part of the fibrous layer of the corium, to be later described in connection with the ampullary tubules. A stout ligament, which extends mesially from the outer end of each of the lateral processes, also lies in this tough tissue, and is thus indirectly connected with the median ligament just above described as well as with its fellow of the opposite side. Gegenbaur (1898) found these three ligaments represented by cartilage in one specimen of *Chimæra*, the ligaments of my specimen thus being capable of undergoing chondrification. The presence of these three ligaments connecting the three rostral processes of *Chimæra*, and their possible chondrification, thus suggest that they and the processes together represent a rostral basket similar to that found in the Carchariidæ and Scylliidæ, but everted. In certain specimens of *Mustelus* I find similar ligamentous or fibrous strands connecting the median and lateral limbs of the rostral basket, and if such a basket were, to be everted, by the lateral limbs passing antero ventrally external to the median limb, the conditions found in *Chimæra* would apparently arise; the lateral processes of *Chimæra* thus representing the basal portions of the lateral limbs of the basket of the Selachii, those portions of those limbs being attached to the nasal capsules as are the processes in my specimens of *Chimæra*.

Garman says that, in *Chimæra monstrosa*, the median rostral process "presents the appearance of having originally been attached near the nasal capsule, as in *Callorhynchus*, and of having the basal portion, for a short distance, brought back against and fused with the frontal region of the skull." This is certainly also the appearance presented by the process in *Chimæra colliei*; but it is probable that this apparent folding backward of this process is due to the marked antero-ventral growth of the anterior portion of the naso-ethmoidal cartilage, the rostral stalk being carried forward beyond the base of the median rostral process. Comparison of Schauinsland's figure 125 of *Callorhynchus*, giving a median vertical sectional view of an embryo of *Callorhynchus*, with the accompanying figure 2 (Pl. I.), giving a similar view of the adult *Chimæra colliei*, will show that this must be so. Comparison with Sewertzoff's figures of embryos of *Pristiurus*, and with Dean's figures of embryos of *Chimæra colliei*, then further shows that, because of the antero ventral growth of this part of the chondrocranium, the antero ventral half of the fenestra præcerebralis has been carried forward on either side of the median rostral process, that the edges of the fenestra anterior to the process have then fused with each other, and that posterior to the rostral process the fenestra has been closed by lateral compression of the cranium, the ethmoidal canals of opposite sides coalescing in the median line and their floors forming the roof of the cranial cavity and their roofs a secondary roof to the cranium. The fenestra præcerebralis is thus completely closed in the adult *Chimæra*, but in embryos of *Callorhynchus* a part of it still persists as the opening *t* of Schauinsland's figures.

A stout ligament arises from the dorsal surface of the chondrocranium at the posterior edge of the nasal capsule, there lying postero-lateral to the corresponding lateral rostral process. This ligament lies at first at right angles to the chondrocranium, and as it is stout and stiff, it looks like a short ligamentous horn which extends to the internal surface of the fibrous layer of the corium above referred to as being related to the tubules of the ampullary organs and to be described immediately below. There the ligament breaks up into numerous branches which spread in every direction along the internal surface of the fibrous membrane. From the anterior surface of the columnar portion of the ligament a branch ligament is sent antero-ventrally beneath the fibrous membrane. The little cartilaginous eminence *s*, shown in Schauinsland's figures of *Callorhynchus* on the dorsal surface of each nasal capsule, corresponds approximately, in position, to this ligament of *Chimæra*.

4. *Ampullæ.*

The ampullæ were examined in two specimens. In one of these specimens there were five large occipital ampullary pores lying in line along the anterior edge of that portion of the supratemporal commissure (lateral canal, Cole, 1896) of the latero-sensory canals that lies between the posterior ends of the supraorbital and infraorbital canals. The tubules that start from these pores immediately penetrate a subepidermal membrane which extends over nearly the entire surface of the head, and, lying in that membrane, between external and internal layers of it, run forward dorsal to the orbit and terminate in a group of five ampullæ that lie immediately dorso-lateral to the median rostral process, these ampullæ also lying between the two layers of the subepidermal membrane. Dorso anterior to the eyeball, between it and the supraorbital latero-sensory canal, there is a group of twelve supraorbital pores, the tubules from which also penetrate the subepidermal membrane and, running antero-ventrally, terminate in an equal number of ampullæ that lie ventral to the ampullæ of the occipital pores and, like them, between the two layers of the subepidermal membrane. Anterior to these supraorbital pores, in the anterior end of the space enclosed between the supraorbital and suborbital latero-sensory canals, there are three groups of pores more or less contiguous one with the other. In the two dorsal groups together there were thirty pores, and in the ventral group twelve pores. The tubules from the two dorsal groups penetrate the subepidermal membrane, and running dorsally, dorso-posteriorly or posteriorly, terminate in ampullæ that lie between the two layers of the subepidermal membrane, close to the ampullæ of the supraorbital pores. The tubules of the ventral group perforate first the outer and then the inner layer of the subepidermal membrane and terminate in ampullæ that lie close against the internal surface of that membrane, in the region between the dorsal and lateral rostral processes. Ventral to this latter group of pores there are numerous pores, many of them minute, covering that portion of the ventro-lateral surface of the snout that lies between the suborbital latero-sensory canal and the supramaxillary fold, and antero-mesial to the point where the supraorbital canal joins the outer buccalis canal. The tubules leading from these pores all run dorsally between the two layers of the subepidermal membrane, and apparently all perforate the inner layer of that membrane and terminate in ampullæ that lie internal to it, in the region between the dorsal and lateral rostral processes. The tissues were, however, here so dense and tough that the relations of all of these ampullæ to the membrane could not be definitely determined.

The ampullæ above described are all innervated by branches of the ramus ophthalmicus superficialis trigemini, these branches being all given off after that nerve issues from the ethmoidal canal through its anterior opening, the branches destined to the ampullæ that lie between the two layers of the subepidermal membrane all perforating the inner layer of that membrane to reach the ampullæ. These ampullæ correspond, in position, to the larger one of the two supraorbital groups of Cole's (1896) descriptions of *Chimæra monstrosa*, the smaller group of supraorbital pores of that author's descriptions having approximately the position, in *Chimæra colliei*, of a group of ampullæ that are innervated by the nervus buccalis.

Cole says (1896, p. 655) that the ramus oticus facialis supplies "the most ventral of the ampullæ opening on the surface by the large occipital pores." No such branches of the ramus oticus could be found in my specimens of *Chimæra colliei*, and as the ampullæ related to these occipital pores all lie on the dorsal surface of the snout, at a great distance not only from the related pores but also from the branches of the oticus shown in Cole's figure, this would seem to be an error.

The buccalis ampullæ are found in three groups, two innervated by the inner buccal nerve of Cole's descriptions and one by the outer buccal. The dorsal group of inner buccalis ampullæ lies on the dorsal surface of the snout, internal to, or slightly posterior to, the occipital and supraorbital groups of ophthalmicus ampullæ, and, like those ampullæ, between the two layers of the subepidermal membrane, these ampullæ having approximately the position of the posterior group of supraorbital ampullæ of Cole's descriptions. The tubules of these ampullæ run postero-ventrally, internal to the ophthalmicus ampullæ and tubules and between the two layers of the subepidermal membrane, and with one exception they all open on the external surface in the space included between the latero-sensory canals innervated by the inner and outer buccalis nerves of Cole's descriptions, the former canal being the one to which I have above referred as the suborbital canal. Nine of these pores form a sub-group which lies in the dorso-posterior corner of that space, while one of them opens somewhat ventro-anterior to that subgroup; and associated with the tubules of these pores there is the one exceptional tubule, which opens by an isolated pore that lies posterior to the posterior hyomandibular latero-sensory canal of Cole's descriptions. A second sub-group, of seven large pores, lies immediately ventral to the inner buccalis suborbital canal, in a large bend at about the middle of its length, and a third sub-group, of ten pores, dorsal to the outer buccalis canal and postero-lateral to the point where that canal is joined by the supraorbital canal.

The second, or ventral group of inner buccalis ampullæ has the position of the group B^4 of Cole's descriptions, and it also lies between the two layers of the subepidermal membrane, about midway between the median and lateral rostral processes. From there the tubules run postero-ventrally, internal to the tubules of the dorsal buccalis ampullæ, and open on the external surface in a long line which begins at the point where the outer buccalis canal falls into the anterior one of the two hyomandibular canals of Cole's descriptions and extends along the dorso-anterior edge of the latter canal until it reaches the postero-ventral end of the supramaxillary fold. There the line of the ampullary pores turns dorso-anteriorly along the edge of the supramaxillary fold, and so continues nearly to the median line.

The outer group of buccalis ampullæ is Cole's group B^4, and it lies ventral to the base of the lateral rostral process. The tubules of these ampullæ all run ventrally and pass internal to the supramaxillary furrow. There two tubules separate from the others, and running mesial to the external nasal aperture open on the external surface immediately ventro-mesial to that aperture. The remaining tubules of the group pass postero-lateral to the external nasal aperture, and open along the ventral edge of the nasal portion of the naso labial fold. These ampullæ and their tubules all lie internal to the inner layer of the subepidermal membrane, but they are surrounded by delicate connective tissues that would seem to represent the corresponding layer of the corium.

Closely related to the ampullary pores on the ventral surface of the snout, there are several patches of small depressions which are the external openings of little glandular structures that are of epidermal origin and form little protuberances on the internal surface of the epidermis, suggesting undeveloped or degenerate ampullæ.

The subepidermal membrane in which, as above described, the larger part of the ampullary tubules lie is formed by the outer fibrous layer of the corium. The latero-sensory grooves, and the calcified cartilaginous rings that partly surround and support them, all lie external to this fibrous layer, as Wright (1884, p. 263) says that the latero-sensory canals of embryos of *Amiurus* also do to the corresponding layer in that fish. The membrane passes external to the three rostral processes, and there encloses a median, three-sided space which lies between the three processes. The membrane is here thick, because of the accumulation of the enclosed ampullary tubules and sacs, and the inner layer of the membrane is markedly reticulated, the meshes in the membrane being traversed by the tubules of certain of the ampullæ and by the nerves that supply the others. The median portion of the three-sided space is filled with loose fatty connective tissue, and the nervus ophthalmicus superficialis of either side, after issuing from the anterior opening of the ethmoidal canal, enters this space and there breaks up into numerous terminal branches. The two layers of the membrane extend into the supramaxillary fold, and apparently end in its ventro-anterior edge. The tubules of the outer buccal group of ampullæ open on the external surface oral to the supramaxillary fold, and they and the related sacs lie internal to the membrane that lodges the other tubules, but, as already stated, fibrous subdermal tissues are found in the lips and the naso-labial folds that seem to correspond to this layer of the corium, but they do not form a definite membrane.

In my work on *Mustelus* (Allis, 1901) no attention was given to the relations of the ampullæ to this fibrous membrane, but I now find, on re-examining my sections of this fish, that the conditions there are strictly similar to those in *Chimæra*. In the work on *Mustelus* I came to the conclusion that each ampullary pore of the adult fish indicated, approximately, the place of origin of the related ampullary organ, the long ampullary tubule of certain of these organs being formed by an exceedingly rapid growth of a primarily short tube, that tube being stretched out between the two relatively fixed points represented by the surface pore and the point where the sensory nerve enters the organ. This has been since confirmed by Coggi (1902), and is further confirmed by the conditions that I have since found in *Chlamydoselachus*, the ampullæ of that fish all having short tubes, and the ampullary sacs all lying immediately beneath the related surface-pores. This marked difference in the positions of the ampullary sacs in this fish and those in *Mustelus* and *Chimæra* evidently needs explanation, and it would seem as if it must be in some way related to the amount of cranial flexure at the time the ampullæ are developed. When the cranial flexure is at its greatest, those portions of the external surface of the head on which the ampullary pores are found in the adult must lie anterior or ventral to the curved anterior end of the central nervous system, and hence in the region of the future rostrum. If the ampullary sacs and the related nerves were well developed at this time, it would seem as if the tendency would be to hold the sacs there when the cranial flexure was later reduced and the brain drawn relatively backward. The dermal tissues would, on the contrary, probably retain their relative relations to the underlying parts of the brain, and hence also be drawn backward; and if the ampullæ had already penetrated the fibrous layer of the corium and continued to lie in it, their short tubes would be drawn out into long tubules lying in the fibrous layer of the corium, as is actually the case in *Mustelus* and *Chimæra*. But if the ampullary sacs were not well developed when the cranial flexure was at its greatest, their tubules could not be stretched, and it would be the related nerve strands that would be lengthened, as in *Chlamydoselachus*. This would not, however, explain why these organs penetrate the fibrous layer of the corium without wholly perforating it, nor why these organs alone enter this layer, the latero-sensory organs and terminal buds all lying external to it, as do apparently also the corresponding tissues of the ear and eye.

CONCLUSIONS.

In the chondrocranium of the adult *Chimæra* the trabeculæ arise from the ventral surface of the parachordals at a considerable distance posterior to their anterior ends, and they project antero-ventrally at a marked angle to the parachordals. This shows that there was not only marked cranial flexure at the time the trabeculæ began to chondrify, but also that this flexure was not, as in the Plagiostomi, later greatly reduced; for that there has here been reversion from the conditions found in the adult Plagiostomi, the cranial flexure being first reduced and then later reacquired, seems wholly improbable. The Holocephali must accordingly be descended from some form in which conditions existed similar to those that are now found in embryos of the Plagiostomi, and as these conditions were probably not found in any adult form, the Holocephali must be descended directly from embryos of the Plagiostomi by conservation and modification of the conditions there found.

The chondrocranium is generally considered to have been formed as a cast which lies between the brain, as a core, and the external epidermis, the form of the cast depending primarily upon the form of the brain. There must accordingly have been some potent influence determining, in these fishes, the retention, by the forebrain, of the position imposed upon it by the marked cranial flexure of embryos. The precocious development of the eyeballs, and their shifting forward and mesially dorsal to the forebrain, where they are actually found in the adult, would doubtless have furnished such an influence; but, unfortunately for this assumption, Schauinsland's descriptions of *Callorhynchus* show that the eyeballs are still widely separated from each other in early embryonic stages, and that the midbrain lies between them. It would accordingly seem as if the determining influence, whatever it may have been, must have been related either to a precocious development of the olfactory organs, or to such a development of the functional mouth.

In all embryos of the Plagiostomi the mouth is at first directed ventrally, and if it became functional before the cranial flexure was reduced, it would evidently tend to remain ventral, this possibly explaining why it is found in this position in the adults of most of these fishes. If in such an embryo the cranial flexure were relatively late in being reduced, or, what is the same thing, if the mouth became precociously functional, the perpetuation of the conditions then existing might give rise to the relations of trabeculæ to parachordals actually found in the adult Holocephali. The eyeballs would then naturally tend to shift forward, and when the head was later compressed latero-mesially they would lie dorsal to the forebrain. The other peculiarities of the chondrocranium would then arise as a result of the anterior ends of the trabeculæ turning dorsally anterior to the forebrain and between the nasal sacs, and then again forward in their terminal portions, represented in the median rostral process.

The peculiar form of the chondrocranium of these fishes would not then be primarily due to developmental adjustments to feeding habits, but to the acquisition of feeding habits adapted to anatomical conditions which were wholly independent of those habits.

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EXPLANATION OF THE PLATES.

The figures are all *natural size*.

PLATE I.

Fig. 1. Lateral view of the head of *Chimæra colliei*, showing the latero-sensory canals and the ampullary pores.
2. Median view of the bisected skull.

PLATE II.

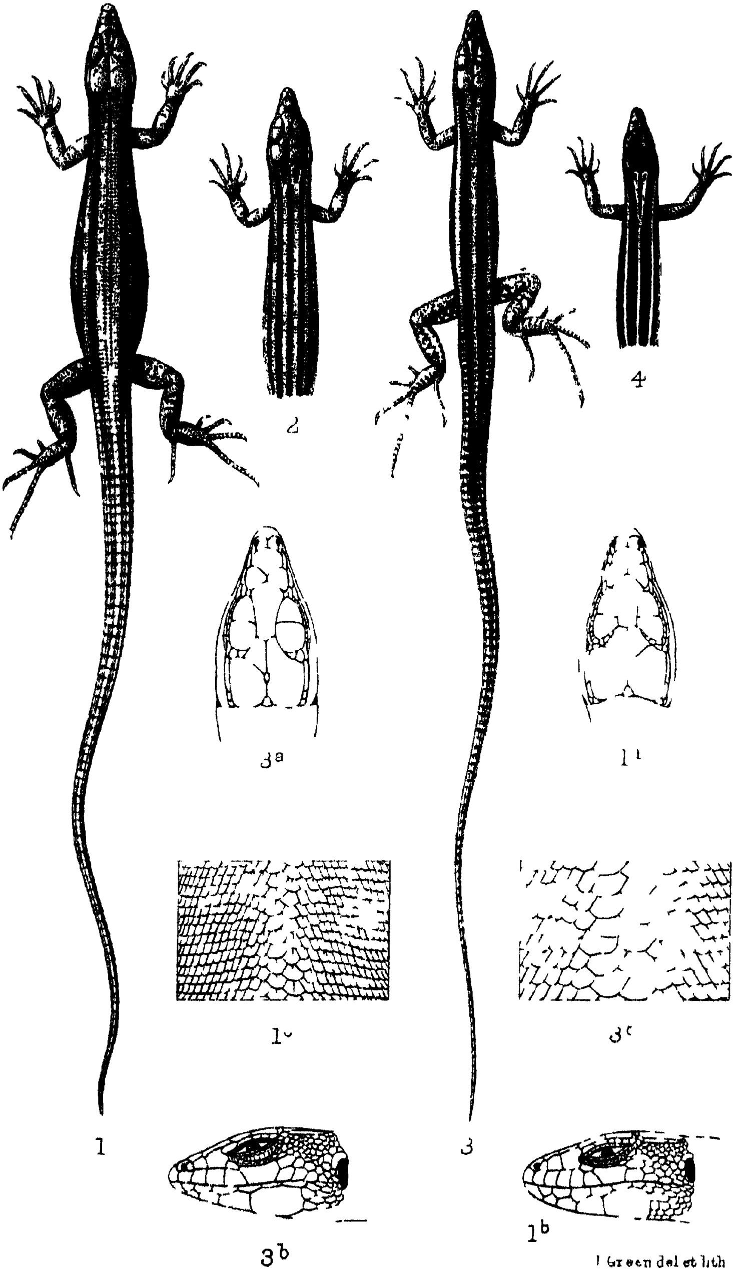
Fig. 3. Lateral view of the skull, with the labial and nasal cartilages in place.
4. Lateral view of the anterior end of the skull, with the ala nasalis and the cartilage *l* in place but the other labial and nasal cartilages removed.
5. The same, with the ala nasalis and cartilage *l* removed.
6. Ventro-anterior view of the end of the snout.

PLATE III.

Fig. 7. Dorsal view of the skull.
8. Ventral view of the skull.
9. Posterior view of the skull.

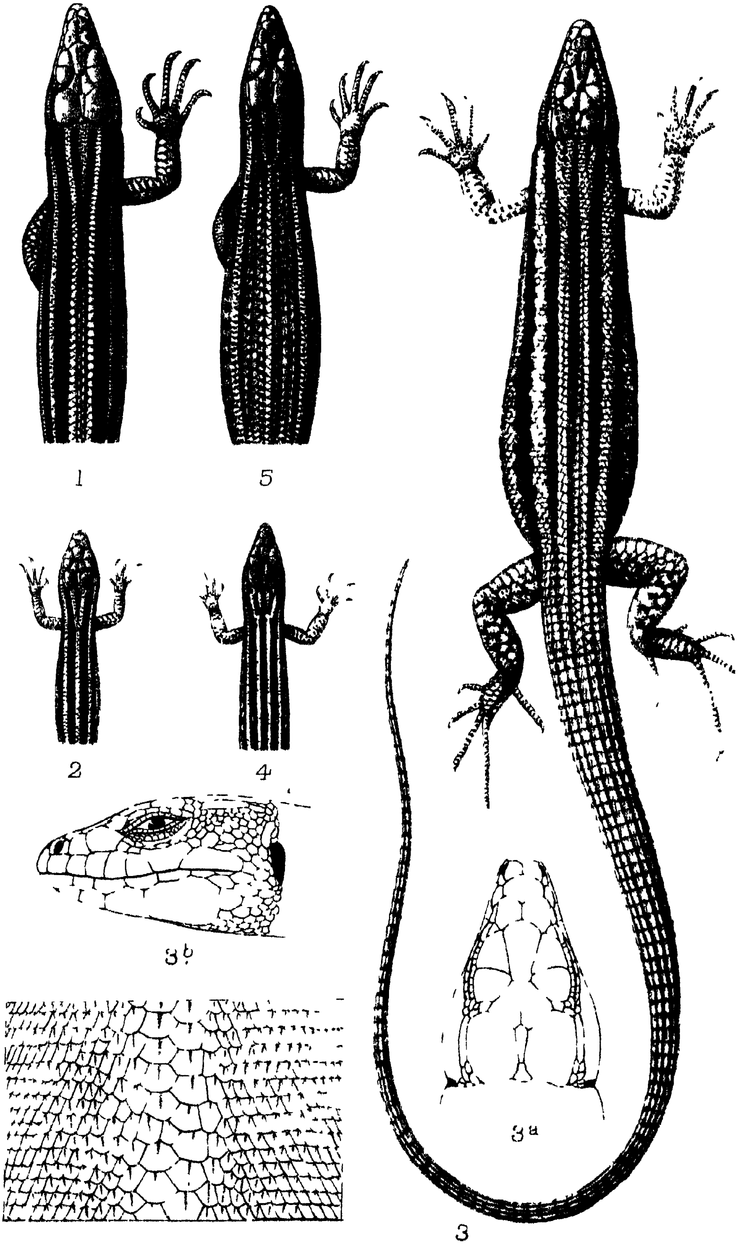
Index Letters.

a,	cartilage *a* of Hubrecht's descriptions.
ab,	foramen for nervus abducens.
acr,	foramen for arteria centralis retinæ.
acv,	foramen for anterior cerebral vein.
adp,	anterior dental plate.
aec,	anterior opening of ethmoidal canal.
ant,	antorbital process.
ccr,	cavum cranii.
e,	cartilage *e* of Hubrecht's descriptions.
ec,	ethmoidal canal.
epsb,	foramen for efferent pseudobranchial artery.
f,	foramen for nerve and artery.
f',	foramen for branch of nervus ophthalmicus.
fa,	foramen for nervus facialis.
fn,	fenestra nasalis.
fv,	foramen for branch of vena nasalis.
fvn,	foramen for vena nasalis.
g,	cartilage *g* of Hubrecht's descriptions.
hmc,	hyomandibular latero-sensory canal.
hmf,	foramen for nervus hyoideo-mandibularis facialis.
hy,	hypophysial groove.
k,	cartilage *k* of Hubrecht's descriptions.
lrp,	lateral rostral process.
m,	cartilage *m* of Hubrecht's descriptions.
md,	mandibula.
mdl,	mandibular labial.
mlf,	mandibular labial fold.
n,	process of cartilage *k*.
nc,	nasal capsule.
nlf,	naso labial fold.
o,	foramen for nervus opticus.
obc,	outer buccalis latero-sensory canal.
ocm,	foramen for nervus oculomotorius.
opf,	foramen for nervus ophthalmicus profundus.
oph,	foramen for nervus ophthalmicus superficialis.
pdp,	posterior dental plate.
pec,	posterior opening of ethmoidal canal.
pf,	foramen for nervus palatinus facialis.
pfg,	perforation for pedicel of cartilage *fg*.
pnb,	prenasal beak.
pnd,	prenasal depression.
pq,	palatoquadrate.
pre,	premaxillary lip.
pst,	postorbital process.
ptf,	pituitary fossa.
pul,	posterior upper labial.
pv,	foramen for pituitary vein.
smxf,	supramaxillary fold.
soc,	supraorbital latero-sensory canal.
sos,	suborbital shelf.
subc,	suborbital latero-sensory canal.
t,	foramen for nervus trochlearis.
tr,	foramen for nervus trigeminus.



J Green del et lith

1, 2 PHILOCHORTUS SPINALIS 3, 4 P PHILLIPSII



J Green del et lith

1 2. PHILOCHORTUS NEUMANNI. 3, 4 P. INTERMEDIUS.
5 P HARDEGGERI.

8. On the Lizards of the Genus *Philochortus* Matschie.

By G. A. Boulenger, F.R.S., F.Z.S.*

[Received January 27, 1917 : Read February 20, 1917.]

(Plates I. & II.†)

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PHILOCHORTUS.

Latastia, part., Bouleng. Cat. Liz. iii. p. 54 (1887).
Philochortus Matschie, Sitzb. Ges. nat. Fr. Berl. 1893, p. 30.

Head-shields normal, save for the occasional absence of the interparietal. Nostril pierced between two nasals and bordered by the first upper labial or narrowly separated from that shield. Lower eyelid scaly, more or less transparent in the middle. Collar well marked. Back with two to six longitudinal series of large plate-like scales; ventral plates feebly imbricate, with truncate posterior border, smooth. Digits more or less compressed, with smooth or keeled lamellar scales inferiorly. Femoral pores. Tail long, cylindrical.

Southern Arabia, Eritrea, Abyssinia, Somaliland.

This genus differs from *Lacerta* and *Latastia* in the longitudinal series of enlarged plate-like scales on the back, an approximation to the condition in *Poromera*, *Tachydromus*, and *Holaspis*.

In all the species the parietal foramen is absent, and a few small teeth are usually present on the pterygoids.

The subdigital lamellæ vary according to individuals; they are usually smooth or with two series of obtuse tubercles; sometimes, however, the tubercles form obtuse keels, and in a female of *P. neumanni* there is a rather sharp keel along the middle. Steindachner has already observed that of the two types of *P. hardeggeri* one has the subdigital lamellæ distinctly keeled, whilst in the other the keels are scarcely indicated.

The species grouped under this genus thus afford another argument against the unnatural division of the Lacertidæ into two main groups, *Liodactyli* and *Pristidactyli*, according to the absence or presence of keels on the lower surface of the digits, which the state of things in *Psammodromus* and *Scaptira* had already led me to abandon.

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† For explanation of the Plates see p. 157.

Synopsis of the Species.

I. Dorsal plates smooth or very feebly keeled; interparietal usually absent or separated from the occipital by the parietals meeting in the middle; usually 4 upper labials anterior to the subocular.; 11 to 15 femoral pores on each side.

30 to 42 dorsal plates and scales across the middle of the body; hind limb not reaching the ear; foot $1\frac{1}{4}$ to $1\frac{2}{5}$ times length of head . *P. spinalis* Peters.

28 or 30 dorsal plates and scales across the middle of the body; hind limb reaching the ear; foot $1\frac{1}{5}$ times length of head . . *P. phillipsii* Blgr.

II. Dorsal plates more or less strongly, rarely feebly keeled; interparietal in contact with the occipital or separated from it by a small shield, usually 5 upper labials anterior to the subocular.

38 to 42 dorsal plates and scales across the middle of the body; 12 to 14 large keeled scales in a transverse series between the hind limbs; supraoculars in contact with the frontal, 29 to 34 gular scales in a longitudinal series; 14 to 16 femoral pores on each side; 33 to 35 lamellar scales under the fourth toe. . *P. neumanni* Matsch.

33 to 40 dorsal plates and scales across the middle of the body. 12 to 18 large keeled scales in a transverse series between the hind limbs; supraoculars in contact with the frontal, 21 to 28 gular scales in a longitudinal series; 12 to 18 femoral pores on each side, 24 to 30 lamellar scales under the fourth toe. . *P. intermedius* Blgr.

24 to 30 dorsal plates and scales across the middle of the body; 8 keeled plates in a transverse series between the hind limbs; supraoculars usually separated from the frontal by a series of granules; 25 to 28 gular scales in a longitudinal series; 11 to 13 femoral pores on each side; 25 to 31 lamellar scales under the fourth toe .. . *P. hardeggeri* Stdr.

1. PHILOCHORTUS SPINALIS. (Pl. 1. figs. 1, 2.)

Lacerta spinalis Peters, Mon. Berl. Ac. 1874, p. 369, pl. - -. fig 2.

Latastia spinalis Bouleng. Cat. Liz. iii. p. 57 (1887); Stejneg. Proc. U.S. Nat. Mus. xvi. 1894, p. 717; Bouleng. Ann. Mus. Genova, (2) xvi. 1896, p. 551; Tornier, Zool. Jahrb., Syst. xxii. 1905, p. 375; O. Neumann, t. c. p. 395.

Head and body feebly depressed. Head $1\frac{1}{2}$ to $1\frac{3}{5}$ times as long as broad, its depth equal to the distance between the anterior corner of the eye and the tympanum, its length 4 to $4\frac{1}{3}$ times in length to vent; snout obtusely pointed, as long as postocular part of head, with obtuse canthus. Pileus twice as long as broad. Neck as broad as the head or a little narrower. Hind limb reaching the shoulder or between the shoulder and the ear in males, the axil or the shoulder in females; foot $1\frac{1}{3}$ to $1\frac{2}{5}$ times as long as head; toes slender, feebly compressed. Tail 2 to $2\frac{1}{2}$ times as long as head and body.

Nostril pierced between 3 shields; nasals forming a suture behind the rostral, the suture $\frac{1}{3}$ to $\frac{2}{3}$ the length of the frontonasal, which is much broader than long and broader than the internarial space; præfrontals forming a short median suture; frontal as long as its distance from the end of the snout, $1\frac{1}{2}$ to

1⅔ times as long as broad, angular in front, much narrower behind, not or but very feebly grooved in front; parietals 1¼ to 1½ times as long as broad, meeting on the median line, the interparietal being small and separated from the occipital, or altogether absent [*]; occipital small [†], triangular. Two large subequal supraoculars, preceded and followed by a small one (first and fourth), often broken up into two or more small shields or granules, the first in contact with the frontal; 6 or 7 superciliaries, separated from the supraoculars by a series of granules. Lower eyelid opaque or somewhat translucid, with feebly enlarged scales in the middle, some of which are deeper than the others. Rostral not entering the nostril; a single postnasal; anterior loreal shorter than the second [‡]; 4, rarely 5, upper labials anterior to the subocular, which is usually narrower beneath than above. A long narrow upper temporal, usually in contact with the fourth supraocular, followed by one or two small shields; upper temporal scales small and granular or hexagonal, lower larger; a more or less distinct tympanic shield.

4 pairs of chin shields, first two or three in contact in the middle; 21 to 29 gular scales between the symphysis of the chin-shields and the median collar-plate, granular in front, gradually or abruptly enlarged and imbricate behind, those of the last row often as large as the plates of the collar; no gular fold. Collar with strongly serrated edge, composed of 7 to 10 plates.

Scales granular on the nape; 2, 4, or, rarely, 6, rows of hexagonal plates along the back, usually smooth, sometimes very feebly keeled; these plates rather small and usually merging gradually into the granular, flat, smooth, or obtusely keeled scales on the sides; 30 to 42 plates and scales across the middle of the body. Ventral plates in 6 longitudinal and 27 to 32 transverse series, the border of the transverse series notched between the plates the median pair of which is narrower than the others. Praeanal plates small and irregular, or two median enlarged.

11 to 15 femoral pores on each side. 27 to 30 lamellar scales under the fourth toe.

Caudal scales forming alternately longer and shorter whorls, upper oblique, rather strongly and diagonally keeled, rounded or obtusely pointed behind, lower feebly keeled, basals smooth; 21 to 28 scales in the fourth or fifth whorl behind the postanal granules.

Young dark brown or black on the body, with 6 yellowish-white longitudinal streaks, the median pair bifurcating on the nape, the outer branch extending to the superciliary edge, and uniting on the base of the tail; the upper lateral streak from the eye to the tail, passing above the tympanum, the lower from the upper lip to the thigh, passing through the tympanum and above the fore limb, reappearing on the back of the thigh; upper surface of head pale brown, with or without darker mottling; upper surface of fore limb pale brown, the shields dark-edged, of hind limb brown with round white spots; lower parts white; tail coral-red. These markings may entirely disappear in the adult, or the dark spaces between the light streaks may be replaced by longitudinal series of dark brown or black spots on a yellowish-brown ground.

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[*] Absent in the type-specimen and in most of the 59 specimens from Ghinda examined by me. I was wrong in thinking the absence of this shield in the type-specimen to be an individual anomaly.

[†] Divided into two in the type-specimen.

[‡] Absent in the type-specimen.

Measurements, in millimetres.

	1.	2.	3.
From end of snout to vent	55	49	52
„ „ fore limb	19	17	18
Head	12	12	12
Width of head	7	7	7
Depth of head	6·5	6	6
Fore limb	19	17	17
Hind limb	34	31	31
Foot	17	16	16
Tail	—	122	123

1. ♂, Rugdeia Sogheira. 2. ♂, Ghinda. 3. ♀, Ghinda.

Particulars of specimens examined.

	1.	2.	3.	4.	5.	6.	7.
♂, Rugdeia Sogheira, Adal	55	34	29	8	26	13 12	29
„ Ghinda	53	34	29	9	21	14 15	30
„ „	49	33	27	9	24	12	27
„ „	49	37	29	7	22	14–15	28
♀, „	55	37	32	8	29	15	29
„ „	52	38	32	7	22	12	28
„ „	47	36	32	7	25	13	28

1. Length to vent (in millimetres). 2. Plates and scales across middle of body. 3. Transverse series of ventral plates. 4. Plates in collar. 5. Gular scales in a straight line between symphysis of chin-shields and median collar plate. 6. Femoral pores (right and left). 7. Lamellar scales under fourth toe.—Same tabulation for the following species.

Habitat. Eritrea. The type-specimen is from Bogos.

I have examined the type-specimen and one from Adal in the Berlin Museum, two from Rugdeia Sogheira, and 59 from Ghinda, in the Genoa Museum.

2. PHILOCHORTUS PHILLIPSII. (Pl. I. figs. 3, 4.)

Latastia phillipsii Bouleng. Ann. & Mag. N. H. (7) ii. 1898, p. 131.

Head and body rather depressed. Head about 1½ times as long as broad, its depth equal to the distance between the centre of the eye and the tympanum, its length a little more than 4 times in length to vent; snout obtusely pointed, as long as postocular part of head, with obtuse canthus. Pileus twice as long as broad.

Neck a little narrower than the head. Hind limb reaching the ear-opening; foot 1½ to 1⅔ times as long as head; toes slender, compressed. Tail 2½ to 2¾ times as long as head and body.

Nostril pierced between 3 shields; nasals forming a suture behind the rostral, the suture ⅓ to ½ the length of the fronto-nasal, which is much broader than long and broader than the internarial space; præfrontals forming a short median suture; frontal as long as its distance from the end of the snout, nearly twice as long as broad, angular in front, much narrower behind, feebly grooved; parietals 1¾ times as long as broad. meeting on the median line between the narrow or very small interparietal and the small triangular occipital. 4 supraoculars, first small, divided into two and in contact with the frontal, second and third large and subequal, fourth small and sometimes divided into two; 5 or 6 superciliaries, separated from the supraoculars by a series of granules. Lower eyelid transparent in the middle, with feebly enlarged scales, some of which are deeper than the others. Rostral not entering the nostril; a single postnasal; anterior loreal shorter than second; 4 upper labials anterior to the subocular, which is a little narrower beneath than above. A long narrow upper temporal, in contact with the fourth supraocular, followed by two small shields; upper temporal scales small and granular, lower large; a distinct tympanic shield.

4 pairs of chin-shields, first three in contact in the middle; 21 gular scales in a straight median line, granular in front, gradually enlarged and imbricate towards the collar, which is formed of 9 plates.

Scales flat, granular on the nape, subimbricate and smooth or faintly keeled on the body, with the two series on the spine much enlarged and plate-like, hexagonal, and twice as broad as long; 28 or 30 plates and scales across the middle of the body. Ventral plates in 6 longitudinal and 26 transverse series, the border of the transverse series notched between the plates, the median pair of which is narrower than the others. Two enlarged præanal plates, one in front of the other, with smaller plates anteriorly and laterally.

13 femoral pores on each side. 27 to 30 lamellar scales under the fourth toe.

Caudal scales forming alternately somewhat longer and shorter whorls, upper oblique, rather strongly keeled, obtusely pointed behind; 20 scales in the fourth or fifth whorl.

Young dark brown above, with 5 yellowish longitudinal streaks, the median bifurcating on the nape, each branch extending to the middle of the posterior border of the parietal shield; the lateral streaks occupying the same position as in *P. spinalis*. Adult grey above, with 3 lemon-yellow longitudinal streaks, the median forked on the nape, and with crowded black dots forming a band from the temple to above the hind limb; limbs speckled with black. Lower parts white. Tail red in the young.

Measurements, in millimetres.

	♂.
From end of snout to vent	42
" " fore limb	16
Head	10
Width of head	6
Depth of head	5
Fore limb	16
Hind limb	29
Foot	16
Tail	114

This species is known from two specimens obtained at Berbera, Somaliland, by Mr. E. Lort Phillips. Distinguished from the preceding by the longer foot and by the light streaks being in odd number on the body.

3. PHILOCHORTUS NEUMANNI. (Pl. II. fig. 1.)

Philochortus neumanni Matschie, Sitzb. Ges. nat. Fr. Berl. 1893, p. 30.

Latastia neumanni Anders. Proc. Zool. Soc. 1895, p. 643, pl. xxxvii. fig. 1; Steind. Denkschr. Ak. Wien, lxix. 1901, p. 330.

Latastia hardeggeri, part., Anders. Proc. Zool. Soc. 1901, ii. p. 145.

Head and body feebly depressed. Head about $1\frac{2}{3}$ times as long as broad, its depth equal to the distance between the centre of the eye and the tympanum. its length 4 to $4\frac{1}{2}$ times in length to vent; snout obtusely pointed, as long as postocular part of head, with obtuse canthus. Pileus twice as long as broad. Neck as broad as the head or a little narrower. Hind limb reaching the collar or between the collar and the ear; foot $1\frac{2}{3}$ to $1\frac{1}{2}$ times as long as head; toes slender, compressed. Tail $2\frac{1}{4}$ to nearly 3 times as long as head and body.

Nostril separated from the upper labial and the postnasal by a narrow rim*; nasals forming a suture behind the rostral, the suture $\frac{1}{4}$ to $\frac{1}{2}$ the length of the frontonasal, which is much broader than long and broader than the internarial space; præfrontals forming a short median suture; frontal as long as its distance from the end of the snout, $1\frac{2}{3}$ to 2 times as long as broad, angular in front, narrower behind, not grooved; parietals $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad; interparietal small, usually separated from the occipital by a small shield. 4 supraoculars, first small and usually in contact with the frontal, second and third large and subequal, fourth small and sometimes broken up into two or three; 6 or 7 superciliaries, separated from the supraoculars by a series of granules. Lower eyelid somewhat transparent, with feebly enlarged scales in the middle, some of which are deeper than the others. Rostral not entering the nostril; a single postnasal; anterior loreal shorter than the second; 5, rarely 4 *, upper labials anterior to the subocular, which is a little narrower beneath than above. A long narrow upper temporal, usually in contact with the fourth supraocular, followed by one or two small shields; temporal scales mostly hexagonal, very small above, larger beneath; a narrow curved tympanic shield.

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* Exactly as in *Lacerta perspicillata*.

5 pairs of chin-shields, first three in contact in the middle; 29 to 34 gular scales in a straight line in the middle, granular in front, gradually or abruptly enlarged and imbricate towards the collar; no gular fold. Collar with strongly serrated edge, composed of 7 to 10 plates.

Scales granular and smooth on the nape, rhombic, juxtaposed or subimbricate, and obtusely keeled on the body; 4 or 6 series of hexagonal plates along the back, more or less strongly keeled; 38 to 42 plates and scales across the middle of the body †; 12 or 14 large keeled scales in a transverse series between the hind limbs. Ventral plates in 6 longitudinal and 28 to 31 transverse series, the border of the transverse series feebly notched between the plates, the median pair of which is narrower than the others. Præanal plates small and irregular, or two large one in front of the other, or three large forming a triangle.

14 to 16 femoral pores on each side. 33 to 35 lamellar scales under the fourth toe.

Caudal scales in alternating somewhat longer and shorter whorls, upper oblique, strongly and diagonally keeled, rounded or obtusely pointed behind, lower keeled; 26 to 30 scales in the fourth or fifth whorl behind the postanal granules.

Brown to blackish above, with six yellowish-white streaks, two along the back, diverging on the nape, and two on each side, the upper from behind the eye to the base of the tail, passing above the tympanum, the lower from the upper lip, through the tympanum and above the fore limb, to the base of the thigh; the dark band between the two light lateral streaks sometimes spotted with whitish; upper surface of head and limbs pale brown; lower parts white; tail pale brown above, yellowish beneath, orange red distally in the young.

Measurements, in millimetres.

	1.	2.	3.
From end of snout to vent	73	82	80
„ „ fore limb	29	29	28
Head	18	19	18
Width of head	11	12	11
Depth of head	9.5	10	9
Fore limb	26	30	26
Hind limb	48	53	47
Foot	25	28	25
Tail	205	190	200

1. ♂, Mt. Manif. 2. ♀, Mt. Manif. 3. ♀, Lahej.

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* In the female from Mt. Manif.

† Anderson's count, 47, is taken higher up the body.

Particulars of specimens examined.

	1.	2.	3.	4.	5.	6.	7.
♂, Mt. Manif . .	73	38	30	7	33	15 16	34
♂, „ .	82	38	29	7	29	11	34
Hgr., „	50	39	28	9	31	15	34
♀, Lahej	80	42	31	8	31	16	33
Hgr., „	53	40	30	10	32	14-15	35

The type-specimen, preserved in the Berlin Museum, has been compared with the specimens from Lahej.

Habitat. This species is only known from South-Western Arabia inland of Aden, specimens having been obtained at Lahej and in the Wadis below Mt. Manif, near Lahej.

4. PHILOCHORTUS INTERMEDIUS, sp. n. (Pl. II. figs. 2, 3.)

Latastia hardeggeri (non Steind.), Bouleng. Ann. & Mag. N. H. (7) ii. 1898, p. 130.

Latastia hardeggeri, part., Anders. Proc. Zool. Soc. 1901, ii. p. 145.

Head and body rather depressed. Head $1\frac{2}{5}$ to $1\frac{2}{3}$ times as long as broad, its depth equal to the distance between the anterior corner or the centre of the eye and the tympanum, its length 4 to $4\frac{1}{3}$ times in length to vent in males, $4\frac{1}{3}$ to 5 times in females; snout obtusely pointed, as long as postocular part of head, with obtuse canthus. Pileus 2 to $2\frac{1}{4}$ times as long as broad. Neck as broad as the head or a little narrower. Hind limb reaching the elbow or the axil in females, the axil, the shoulder, or the collar in males; foot $1\frac{1}{3}$ to $1\frac{1}{2}$ times as long as head; toes slender, compressed. Tail 2 to $2\frac{1}{4}$ times as long as head and body.

Nostril separated from the upper labial and the postnasal by a narrow rim; nasals forming a suture behind the rostral, the suture $\frac{1}{3}$ to $\frac{2}{3}$ the length of the frontonasal, which is broader than long and broader than the internarial space; præfrontals forming a short median suture; frontal as long as its distance from the end of the snout or a little shorter, $1\frac{2}{3}$ to 2 times as long as broad, angular or rounded in front, narrower behind, not or but feebly grooved; parietals $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad; interparietal 2 to 3 times as long as broad, in contact with the occipital, which is usually broader and about half as long. 4 supraoculars, first small, sometimes broken up into 2 or 3, and as often as not in contact with the frontal, second and third large and equal or second a little longer, fourth small and usually broken up into 2 or 3; 6 or 7 superciliaries, separated from the supraoculars by a complete series of granules, or first in contact with the first and second supraoculars. Lower eyelid somewhat transparent, with feebly enlarged scales in the middle, some of which may be deeper than the others. Rostral not entering the nostril; a single postnasal; anterior loreal shorter than the second; 5, rarely 4 *, upper labials anterior to the subocular, which is narrower beneath than above. A long narrow upper temporal, usually in contact with the fourth supraocular, usually followed by one or two small shields; temporal scales very small and granular above, much larger beneath; a curved tympanic shield.

4 pairs of chin shields, sometimes followed by a small fifth, first three in contact in the middle; 21 to 28 gular scales in a straight line in the middle, granular in front, gradually or abruptly enlarged and imbricate towards the collar; no gular fold. Collar with strongly serrated edge, composed of 7 to 10 (exceptionally 4) plates.

Scales granular and smooth on the nape, rhombic and keeled on the body; 2 or 4 series of hexagonal plates along the back, more or less strongly keeled, rarely faintly keeled; 33 to 40 plates and scales across the middle of the body; 12 to 18 large keeled scales in a transverse series between the hind limbs. Ventral plates in 6 longitudinal and 27 to 32 transverse series (27 to 30 in males, 30 to 32 in females). the border of the transverse series feebly notched between the plates, the median pair of which is narrower than the others. Praeanal plates small and irregular, or two or three enlarged ones in the middle, in a series or three forming a triangle.

12 to 18 femoral pores on each side. 24 to 30 lamellar scales under the fourth toe.

Caudal scales in alternately somewhat longer and shorter whorls, upper oblique, strongly and diagonally keeled, rounded or obtusely pointed behind, lower keeled; 24 to 28 scales in the fourth or fifth whorl behind the postanal granules.

Young black on the upper surface of the body, with 6 yellow streaks, the median pair diverging towards the occiput, to embrace an additional pair of short streaks, or each streak bifurcating just before reaching the occiput; the upper lateral streak extends from behind the eye to the base of the tail, passing above the tympanum, the lower from the upper lip, through the tympanum and above the fore limb, to the thigh; head and upper surface of fore limbs brown, hind limbs and tail coral-red, throat and belly white.

These markings may persist more or less distinctly in the adult, which vary much in colour; the blackish bands between the light streaks may be much spotted with whitish, or broken up into spots, or the upper parts may be grey, brown, or reddish with 7 blackish longitudinal streaks (9 behind the occiput) or merely with two series of blackish spots on each side. Tail often reddish towards the end.

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* 4 in two specimens only.

Measurements, in millimetres.

	1.	2.	3.	4.	5.
From end of snout to vent	71	68	56	85	53
„ „ fore limb	27	25	20	25	17
Head	18	17	13	17	11
Width of head	11	11	8	12	7
Depth of head	9	8	6·5	9	6
Fore limb	24	24	18	26	16
Hind limb	42	42	29	45	29
Foot	22	23	16	25	15
Tail	175	180	145	200	—

1. ♂, Wagga. 2, 3. ♂, Berbera. 4, 5. ♀ (gravid), Berbera.

Particulars of specimens examined.

	1.	2.	3.	4.	5.	6.	7.
♂, Wagga	76	40	30	9	28	16–14	26
„ „	71	34	29	9	27	18–17	30
„ „	52	36	28	7	24	14	27
♀, „	57	38	30	7	26	14–16	27
♂, Berbera	43	34	27	9	22	12	28
„ Inland of Berbera	68	40	28	9	27	16	29
„ „	68	37	29	9	25	16–15	27
„ „	56	36	29	11	25	14	28
„ „	55	39	29	8	25	15–14	27
„ „	55	36	28	10	24	14–15	24
„ „	53	36	29	4	23	14	28
„ „	53	34	28	8	23	14 13	26
„ „	51	40	27	9	26	13	29
♀, „	85	36	30	7	25	14–15	25
„ „	85	37	32	8	26	16–15	29
„ „	80	36	30	9	24	15–14	28
„ „	75	37	30	9	25	16–15	29
„ „	71	39	31	10	28	17–16	30
„ „	67	40	30	9	24	15	28
„ „	58	34	30	9	25	14	27
„ „	55	39	31	8	23	13	28
„ „	53	33	30	10	21	15–13	25
„ „	51	36	30	8	23	14–13	29

Habitat. Northern Somaliland at and near Berbera.

5. PHILOCHORTUS HARDEGGERI. (Pl. II. figs. 4, 5.)

Latastia hardeggeri Steind. Ann. Hofmus. Wien, vi. 1891, p. 371, pl. xi.; Bouleng. Zool. Rec. 1893, Rept. p. 23; Tornier, Zool. Jahrb., Syst. xxii. 1905, p. 375.

Eremias heterolepis, Boettg. Zool. Anz. 1893, pp. 115, 193.

Latastia degeni Bouleng. Ann. & Mag. N. H. (7) xi. 1903, p. 55.

Head and body rather depressed. Head about 1½ times as long as broad, its depth equal to the distance between the anterior corner or the centre of the eye and the tympanum, its length 4⅛ to 5 times in length to vent; snout pointed, as long as postocular part of head, with rather sharp canthus. Pileus 1¾ to 2 times as long as broad. Neck as broad as the head or a little narrower. Hind limb reaching the shoulder, the collar, or between the collar and the ear; foot 1⅖ to ⅗ times as long as head; toes slender, compressed. Tail 2⅔ to 3¼ times as long as head and body.

Nostril between three shields, or separated from the upper labial and the postnasal by a narrow rim; nasals forming a suture behind the rostral, the suture ¼ to ⅔ the length of the frontonasal, which is much broader than long and broader than the internarial space; præfrontals forming a short median suture; frontal as long as its distance from the end of the snout or a little shorter, 1½ to 1⅔ times as long as broad, angular or rounded in front, narrower behind, distinctly grooved; parietals 1¼ to 1⅓ times as long as broad, in contact with the upper postocular; interparietal extremely narrow, in contact with or narrowly separated from the very small occipital *. Two large supraoculars, subequal or anterior the shorter, entirely surrounded by a series of granules †, of which larger ones represent the first and fourth supraoculars; 5 or 6 superciliaries. Lower eyelid somewhat transparent, with feebly enlarged scales in the middle, some of which may be deeper than the others. Rostral not entering the nostril; a single postnasal; anterior loreal shorter than second; 5 upper labials anterior to the subocular, which is narrower beneath than above. A long narrow upper temporal, followed by a shorter shield; temporal scales very small and granular above, much larger beneath; a small curved tympanic shield usually present.

4 pairs of chin-shields, first three in contact in the middle; 25 to 28 gular scales in a straight line in the middle, granular in front, gradually or abruptly enlarged, and imbricate towards the collar; no gular fold. Collar with strongly serrated edge, composed of 7 or 8 plates.

Scales granular and smooth behind the occiput, rhombic, subimbricate, and keeled on the body; 4 or 6 series of hexagonal strongly keeled plates along the back, 8 between the hind limbs. 24 to 28 ‡ plates and scales across the middle of the body. Ventral plates in 6 longitudinal and 27 to 30 transverse series, the border of the transverse series feebly notched between the plates, the median pair of which is narrower than the others. Præanal plates small and irregular, or one enlarged.

11 to 13 femoral pores on each side. 25 to 31 lamellar scales under the fourth toe.

Caudal scales in nearly equal whorls, upper oblique, strongly

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* A small shield between the interparietal and the occipital in one young specimen.

† In one of the two type-specimens described by Steindachner, the circle of granules is incomplete, the supraoculars being in contact with the frontal.

‡ 30 in the type of *Eremias heterolepis*, according to Boettger.

and diagonally keeled, pointed and more or less distinctly mucronate behind, lower keeled, except the basals; 22 to 28 scales in the fourth or fifth whorl behind the postanal granules.

Young black above with five yellowish-white longitudinal streaks, the median bifurcating on the nape, the two laterals as in the preceding species; head and limbs brown above, hind limbs with round white spots; throat and belly white, lower surface of hind limbs and tail coral-red. Adult brown above, with a more or less distinct yellow vertebral streak, bifurcating on the nape and extending some way down the tail; each of the dorsal plates with a small blackish spot; sides of body pale greyish brown, with a series of large blackish spots or bars; lower parts white.

Measurements, in millimetres.

	1.	2.	3.
From end of snout to vent	70	70	56
„ „ fore limb	23	24	19
Head	14	14	13
Width of head	10	9	8
Depth of head	7	8	6
Fore limb	22	22	18
Hind limb	42	38	34
Foot	22	21	18
Tail	180	170	155

1. ♂, Berbera. 2. ♀, Berbera. 3. ♀, Mandah, type of *L. degeni*

Particulars of specimens examined.

	1.	2.	3.	4.	5.	6	7.
♂, Berbera	70	24	27	7	25	11	26
♀, „	70	26	30	7	28	11	25
„ „	65	26	28	7	28	12-13	28
„ Mandah	56	24	30	7	26	11	31

Habitat. Northern Somaliland and Abyssinia. The type-specimens, preserved in the Vienna Museum, are from between Hensa and Artec, near Harrar.

This species is distinguished from the two preceding by the lower number of plates and scales across the body, and by the nearly constant presence of a series of granules between the supraoculars and the frontal; also by the light vertebral streak.

List of the Specimens in the British Museum.

Philochortus spinalis Peters.

1. ♂.	Rugdeia Sogheira, Adal, Eritrea.	Marquis O. Antinori.
2-9. ♂ ♀ & yg.	Ghinda, Eritrea.	Signor Ragazzi.

Philochortus phillipsii Blgr.

1-2. ♂ & hgr., types.	Berbera, Somaliland.	E. Lort Phillips, Esq.

Philochortus neumanni Matschie.

1–2. ♀ & hgr.	Lahej, near Aden.	Col. Yerbury.
3–5. ♂ ♀ & hgr.	Wadis below Mt. Manif, N. of Lahej.	A. B. Percival, Esq.

Philochortus intermedius Blgr.

1–10. ♂ ♀ & yg., types.	Wagga, Goolis Mts., 3000–4000 ft., Somaliland.	G. W. Bury, Esq.
11. ♂, type.	Berbera, Somaliland.	E. Lort Phillips, Esq.
12–30. ♂ ♀ & yg., types.	Inland of Berbera, up to 400 ft.	G. W. Bury, Esq.

Philochortus hardeggeri Stdr.

1. ♂, type of *Latastia degeni.*	Mandah, Somaliland.	Mr. E. Degen.
2–6. ♂ ♀ & yg.	Inland of Berbera, up to 400 ft.	G. W. Bury, Esq.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1.	*Philochortus*	*spinalis.*	p. 146, ♀, nat. size.
1 *a.*	”	”	Upper view of head, × 2.
1 *b.*	”	”	Side ” ” ”
1 *c.*	”	”	Scales in middle of back, × 3.
2.	”	”	Young, nat. size.
3.	”	*phillipsii,*	p. 148, ♂, nat. size.
3 *a.*	”	”	Upper view of head, × 2.
3 *b.*	”	”	Side ” ” ”
3 *c.*	”	”	Scales in middle of back, × 4.
4.	”	”	Young, nat. size.

PLATE II.

Fig. 1.	*Philochortus*	*neumanni,*	p. 150, ♂, nat. size.
2.	”	*intermedius,*	p. 152, ♀, nat. size.
2 *a.*	”	”	Upper view of head, × 2.
2 *b.*	”	”	Side ” ” ”
2 *c.*	”	”	Scales in middle of back, × 3
3.	”	”	Young, nat. size.
4.	”	*hardeggeri,*	p. 154, ♀, nat. size.
5.	”	”	Young, nat. size.

9. An Experimental Investigation of the Migration of Woodcock breeding in the West of Ireland. By S. R. Douglas, M.R.C.S., L.R.C.P. Lond., Captain I.M.S. (retired), F.Z.S., 1st Assistant Bacteriological Department, Medical Research Committee, National Insurance Act.

[Received February 15, 1917: Read March 6, 1917.]

To ascertain if the woodcock breeding in the British Islands are migratory in their habits has from time to time been the subject of investigations. These investigations have usually taken the form of marking a number of nestling birds, generally by means of metal rings placed round the legs, and collecting the data furnished by the recovery of these birds in various localities.

The best known of such experiments which have been published up to the present time are: –

(i.) That made on the Duke of Northumberland's estate at Alnwick and reported by Lord William Percy in 'Country Life,' 1909, Feb. 27th.

(ii.) That made at Baron's Court, Co. Tyrone, and reported by Hamilton in 'The Field,' 1908, Oct. 17th, p. 717, and Oct. 24th, p. 745

(iii.) Other references dealing with smaller experiments are to be found in 'British Birds,' vol. iv. p. 280, and vol. v. p. 186; and also in the report of the Aberdeen University Bird Migration Inquiry.

The experiment, the details of which are here given, has been carried out at the instigation of Col. W. W. Ashley, M.P., of Broadlands, Romsey, Hampshire, and the Palmerston Estates, Co. Sligo, who has most kindly given me permission to publish the results obtained up to the present time.

Before giving the actual details of the numbers of birds marked year by year and the numbers recovered, etc., it is necessary to describe accurately the situation where the experiment was carried out, and to give a description of the breeding-grounds, together with a few notes on the nesting-habits of woodcock in this locality.

Col. Ashley's property consists of a strip of country lying between the Ben Bulben range and the southern shore of the Bay of Donegal in the County of Sligo, the position being almost exactly 8° 30′ west and 54° 30′ north.

It is composed largely of small holdings which have been vested in the tenants under the various Land Acts, but it also contains a considerable extent of bog-land and some fine coverts made up of both hard and soft wood trees. These woods during the winter months harbour a considerable number of woodcock, affording excellent sport: in exceptional years large bags have been made, for instance, in January 1892, 92 and 98 cock were shot on consecutive days; the more usual bags, however, are about 120 cock for two guns in a week's shooting.

Woodcock have only comparatively recently nested regularly in these parts, for, from information received from a former keeper of Col. Ashley's, Mr. R. Bracken, who had been brought up in this part of the country and who has several relatives keepers on neighbouring estates, it appears quite certain that a woodcock's nest was considered the greatest rarity before the year 1875. Since that date they have become more and more numerous. On Col. Ashley's property, and especially in respect of the principal breeding-ground described below, woodcocks' nests were practically unknown before the year 1900.

The principal breeding-ground is a wood about 150 acres in extent, situated about the centre of the property. This wood, which was planted about 1830, consists almost entirely of Scotch and Maritime fir, and lies within half a mile of the sea. The soil is very sandy, and the ground between the wood and the sea-shore is occupied by sand dunes covered with bent grass.

That part of the wood where most of the woodcock nest is occupied by well-grown pine-trees, and is practically destitute of any undergrowth, the ground between the tree-trunks being thickly carpeted with moss and fallen pine-needles, with here and there heaps of fallen sticks.

The nests are most frequently placed at the foot of a well-grown tree; they consist of a saucer-shaped depression in the moss with no more lining than a few pine-needles, and are often partly shielded from view by some fallen dead wood.

The usual number of eggs laid is four, but nests containing five have been found. One egg in the clutch frequently fails to hatch out. The average of 50 nests is now found every breeding-season in this wood.

The nesting-season commences in March, a nest with eggs having been found as early as the fifth of this month, and continues throughout the summer until the end of July or the beginning of August; however, most of the young are hatched in the months of April, May, and the early part of June.

The young birds grow very rapidly after being hatched out, and within two or three days leave the locality of the nest, so that the marking of the young birds has to be carried out very soon after they are hatched.

No definite proof of a woodcock raising two broods in the year has been obtained, but all the keepers are of the opinion that this at any rate occasionally happens.

The young birds remain near the place of their birth until about the middle of September. About this time, however, they practically all disappear until the middle of October, when a number of birds are again seen, and these appear to constitute the regular winter inhabitants of the different coverts.

The experiment was commenced in the year 1910, and has been continued every year since then. The number of marked birds that have been recovered varies considerably in different years, this being mainly due to there being practically no shooting during certain seasons.

For the first three years the birds were marked by having a single ring placed on one leg; this ring was made of aluminium and stamped with the lettering "A.C. 10" in the year 1910, while in 1911 and 1912 the lettering was "W.A. Sligo, 1911," and "W.A. Sligo, 12" respectively.

After the year 1912 two rings were used, one ring being placed on each leg. The reason for this was that it was ascertained that the postal authorities would not deliver letters which were addressed with initials only, a fact that may account for the scarcity of information from outside sources received in the earlier years of the experiment.

The lettering on these rings was "W. Ashley" on the one ring, and on the other "Sligo 13"-14"-15"-16," according as the year was 1913, 1914, 1915, or 1916.

The following table gives the number of birds marked and the lettering on the rings for each year:—

TABLE I.

Date.	No. of birds marked.	Lettering on rings.
1910.	33	One ring, "A.C. 10"
1911.	48	One ring, "W.A. Sligo. 1911."
1912.	50	One ring, "W.A. Sligo, 12."
1913.	50	Two rings, "W. Ashley" & "Sligo 13."
1914.	50	Two rings, "W. Ashley" & "Sligo 14."
1915.	50	Two rings, "W. Ashley" & "Sligo 15."
1916.	50	Two rings, "W. Ashley" & "Sligo 16."

This gives a total of 331 birds marked in seven years. All these birds with the exception of seven were hatched in the large pine-wood described above. The seven exceptions, consisting of two in 1910, two in 1911, and three in 1912, were young birds taken from nests in some of the outlying coverts.

The total number of marked birds that have been recovered is 55, that is 16·6 per cent.

The following table gives (i.) the number of birds recovered year by year; (ii.) the locality in which they were found; (iii.) the date the bird was marked; (iv.) the date the bird was recovered; (v.) the method of recovery.

In respect to the various names of places on the estate, Classiebawn includes the large pine wood and its immediate surroundings, Cloonkeen, Carnduff, Bunduff, and Castlegal being the local names of various portions of Col. Ashley's estate, and all of them lie within 3 miles of the principal breeding-ground. To simplify the reading of the table the letter (E.), signifying estate, is placed after these place-names.

For convenience the years are reckoned in shooting-seasons.

In the case of birds recovered outside the estate the approximate distance and bearing are given.

TABLE II.

Year. Aug. 1st to July 31st.	No. of birds recovered and locality.	Date the bird was marked.	Date and method of recovery.
1910–1911.	1, Hazlewood, an estate 10 miles to the south.	1910.	Nov. 1910. Shot.
	1, Cloonkeen (E.)	1910.	Feb. 1911. Shot.
1911–1912.	1, Castlegal (E.)	1911.	Nov. 1911. Shot.
	1, Carnduff (E.)	1911.	Nov. 1911. Shot.
	4, Classiebawn (E.)	1911.	Nov. 1911. Shot.
	1, Castlegal (E.)	1911.	Dec. 1911. Shot.
	1, Classiebawn (E.)	1911.	Jan. 1912. Shot.
	1, Cloonkeen (E.)	1911.	Jan. 1912. Shot.
	1, Castlegal (E.)	1911.	Jan. 1912. Shot.
	1, Cloonkeen (E.)	1910.	Jan. 1912. Shot.
1912–1913.	4, Classiebawn (E.)	1912.	Dec. 1912. Shot.
	3, Cloonkeen (E.)	1912.	Dec. 1912. Shot.
	1, Cloonkeen (E.)	1911.	Jan. 1913. Shot.
	1, Classiebawn (E.)	1911.	June 1913. Found dead.
	1, Classiebawn (E.)	1910.	June 1913. Found dead.
1913–1914.	1, Classiebawn (E.)	1911.	Jan. 1914. Shot.
	8, Classiebawn (E.)	1913.	Jan. 1914. Shot.
	1, Bunduff (E.)	1912.	Jan. 1914. Shot.
	1, Bunduff (E.)	1913.	Jan. 1914. Shot.
	1, Hazlewood, an estate 10 miles to the south.	1913.	Jan. 1914. Shot.
1914–1915.	1, Morga, Biscay, Spain, about 800 miles due south.	1914.	Nov. 1914. Shot.
	1, Castlegore, Co. Mayo, about 40 miles to south-west.	1914.	Dec. 1914. Shot.
	1, Glencar, Co. Sligo	1914.	Feb. 1915. Shot.
	1, Classiebawn (E.)	1914.	April 1916. Found dead, killed by a hawk.
1915–1916.	3, Classiebawn (E.)	1914.	May 1916. Found dead, killed by a hawk.
1916–1917.	1, Bridgetown, Co. Donegal, 60 miles to the north-east.	1913.	Nov. 1916. Shot.
	1, Mullins, Co. Donegal, 15 miles to the north-east.	1915.	Nov. 1916. Caught in rabbit-trap.
	1, Classiebawn (E.)	1910.	Jan. 1917. Shot.
	1, Classiebawn (E.)	1913.	Jan. 1917. Shot.
	1, Classiebawn (E.)	1915.	Jan. 1917. Shot.
	6, Classiebawn (E.)	1916.	Jan. 1917. Shot.
	1, Carnduff (E.)	1914.	Jan. 1917. Shot.
	1, Carnduff (E.)	1915.	Jan. 1917. Shot.

Besides these, two other ringed birds have been reported, but were not actually obtained by any responsible person.

One with one ring only was caught by a cat in 1915, and therefore was a bird marked in 1910, 1911 or 1912; the other with rings of the year 1916 is said to have been shot by a poacher in 1916.

On looking over this table the most striking fact is the large number of marked birds which have been recovered on the estate, the actual number being 48 out of the total of 55 birds recovered, and of these no fewer than 33 were obtained either in the large wood forming the main breeding-ground or its immediate vicinity.

Of the seven birds which have been recorded as obtained in other situations three were shot within a radius of ten miles in a southerly direction, two at Hazlewood, and one at Glencar, about 6, 7, and 9 months after being marked.

One was shot at Castlegore, Co. Mayo, which is about 40 miles to the south-west, about six months after being marked. One was noticed in the market-place of Bilbao, having been shot at Morga, in the province of Biscay, Spain, within six months of being marked, the distance in a direct line being about 800 miles.

It is therefore to be noticed that all the birds which have been recovered south of the breeding-place have been obtained within 9 months of their being marked.

Two birds were recovered north of the breeding place, one about 15 miles to the north east in the townlands of Mullins, Co. Donegal, 1½ years after being marked, and the other near Bridgetown, Co. Donegal, 60 miles to the north-east, 3½ years after being marked.

The small number of birds recovered during the years 1914–1915 and 1915 1916 is accounted for by the fact that owing to the war there was very little shooting in these years.

Table III. (p. 164) gives (i.) the year, (ii.) the number of birds marked, (iii.) the number of birds recovered, (iv.) the date the birds were recovered.

This table is inserted so as to bring out some of the data already given in a more convenient form; one point to which attention may be drawn is that a bird marked in 1910 was shot in Jan. 1917, so that it must have been at least 6½ years old.

On examining this bird no evidence of old age could be detected, and its weight, which was 13 oz., was rather above the average.

With regard to the weight of woodcock, on two occasions when a considerable number of ringed birds have been obtained, the weights of these birds have been compared with the weights of the unmarked birds obtained on the same day. Thus, on Jan. 2nd, 1914, nine ringed birds and eight unringed birds were shot.

The weights of the nine ringed birds were:—11, 11·5, 11·5, 11·75, 11·75, 12·25, 12·25, 12·75, and 13 ounces respectively, giving an average of 11·97 oz.

TABLE III.

Year.	No. of birds marked.	No. of birds recovered.	Dates the birds were recovered.
1910.	33	5	1, Nov. 1910. 1, Feb. 1911. 1, Jan. 1912 1, June 1913. 1, Jan. 1917.
1911.	48	13	6, Nov 1911. 1, Dec. 1911. 3, Jan. 1912. 1, Jan. 1913. 1, June 1913. 1, Jan. 1914
1912.	50	8	7, Dec. 1912. 1, Jan 1914.
1913.	50	12	10, Jan. 1914. 1, Nov. 1916. 1, Jan. 1917.
1914.	50	8	1, Nov. 1914. 1, Dec. 1914. 1, Feb. 1915. 1, April 1915. 3, May 1916. 1, Jan. 1917.
1915.	50	3	1, Nov. 1916. 2, Jan. 1917.
1916.	50	6	6, Jan. 1917.

The weights of the eight unringed birds were:—10, 11, 11, 11·5, 11·5, 11·5, 11·75, and 12·25 ounces respectively, giving an average of 11·3 oz.

Again on Jan. 15th, 1917, eight ringed and sixteen unringed birds were shot. The weights of the ringed birds were:—11·25, 12, 12·25, 12·25, 13, 13, 13·5, and 14·25 ounces respectively, giving an average of 12·7 oz.

Those of the sixteen unringed birds were:—10·5, 11·5, 11·5, 11·75, 11·75, 12, 12, 12, 12·25, 12·25, 12·5, 13, 13, 13·25, 13·5, and 14 ounces respectively, giving an average weight of 12·3 oz.

The following day 31 unringed birds gave an average weight of 12·1 oz.

Although these numbers are not great, it is worthy of note that on both occasions the average weight of the ringed birds was greater than that of the unringed birds.

These being the data obtained up to the present time, is it justifiable to draw any conclusions from them?

The first point, and this may be taken as conclusively proved, is that many of the woodcock which are hatched out in this locality remain there throughout the following winter months.

The second point is that at any rate a proportion of the woodcock hatched out in this locality remain in the neighbourhood for several years, and, even if they at some period or other migrate to other places, they return to nest: this is indicated not only by the recovery of several marked birds during the nesting-season, but also by the fact that on more than one occasion a nesting-bird flushed from the nest has been noticed to be a ringed bird.

The third point is that five woodcock have been recovered in localities situated at various distances south of the breeding-centre, all within a few months of their being hatched out of the egg, and, although the numbers are few, it indicates that some of the birds tend to migrate south in the autumn months.

A fourth point worthy of notice is that the woodcock appears to show a decided preference for a large-sized pine-wood free from undergrowth, as a nesting-ground, to any other type of covert.

The fifth point is that on two occasions a number of ringed birds have given a larger average weight than a number of unringed birds, indicating that the "resident birds" are rather heavier than the winter migrants.

In conclusion, the data already collected point to their being three classes of woodcock in this part of the west of Ireland, namely:—

(i.) Woodcock that are hatched out and remain in this locality, sometimes for years, that is "resident birds."

(ii.) Woodcock that are hatched out in this locality and then migrate in a southerly direction.

(iii.) Woodcock that arrive from the north during the winter months.

These classes are comparable to those into which Eagle Clarke divided the starlings of Shetland.

Finally, let me point out most emphatically that any success which this experiment may have achieved in elucidating the habits of woodcock is largely due to the care and zeal with which Col. Ashley's keepers, Messrs. Jules, Arthur and Walter Bracken have carried out their work. Their knowledge and powers of observation have furnished many of the points of interest recorded in this paper.

10. A Sketch Classification of the Pre-Jurassic Tetrapod Vertebrates. By D. M. S. Watson, M.Sc., F.Z.S., Lecturer in Vertebrate Palæontology in University College, London.

[Received February 20, 1917: Read March 20, 1917.]

(Text-figures 1 & 2.)

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The enormous expansion of our knowledge of early Tetrapods during the last twenty years, which we owe especially to the work of Broili, Broom, Case, v. Huene, Moodie, and Williston, has led to the general realisation of the inadequacy of our existing scheme of classification.

It is the purpose of this paper to produce a classification of these animals which, whilst including all existing information and paying attention to the taxonomic views of other students, shall be so far as possible a consistent whole expressing my own view of the relationships of the forms which fall within its scope.

The difficulties of classification of early Tetrapods are identical with those which lead to divergence between those classifications of the early Eocene placental mammals characteristic of the American and European schools.

Most American authors, for example, follow Osborn in dividing the Lower Eocene Perissodactyls, which are all very much alike in structure, between the families of Horses, Tapirs, Rhinoceroses, Lophiodonts, Calicotheres, and Titanotheres, whilst European authorities include them all in the one family Lophiodontidæ, ancestral to all other families of Perissodactyls.

Both methods are quite legitimate, expressing as they do different aspects of the subject.

Prof. Osborn's method has the great merit of forcing attention to the consideration of the small details which persist throughout families, and of bringing out clearly our knowledge of actual lines of descent. Its drawbacks are that, without a very considerable knowledge not only of one animal, but of its descendants, it is impossible to be certain of its position in the system, and that the families are with difficulty, if at all, definable.

The other method, of having large primitive families ancestral to all later lines of an order, has the advantage of emphasising the great resemblances between all members of an order in its early youth and of giving readily definable families into which any relatively well-known type can be securely placed. It suffers from the disadvantage that whilst emphasising resemblances it is liable to obliterate remembrance or recognition of differences.

As in my opinion the study of early Tetrapods is at present suffering from an insufficient appreciation of the differences that do exist, the following scheme will follow Prof. Osborn's method, although I fully realise that this course leads to a multiplication of Orders and to the placing of many types as incerta sedis.

BATRACHIA. Macartney, 1802.

Tetrapods which, either in a larval stage or persistently, breathe by gills.

Super-Order LABYRINTHODONTIA (Owen).

Amphibia with a roofed skull, a lower jaw consisting of at least eight bones on each side, and vertebræ consisting of neural arches and intracentra in all forms, with pleurocentra in addition in most.

Grade **EMBOLOMERI** Cope.

Labyrinthodonts with large well-ossified basioccipital and basisphenoid. Occipital condyle single or triple. Pterygoids with a large palatal part, articulating by movable facets with definite basipterygoid processes of the basisphenoid. Interpterygoid vacuities very small. Tabulars and dermo-supraoccipitals without occipital extensions.

Family ANTHRACOSAURIDÆ Cope, 1875.

Embolomeri with a single occipital condyle. No specialised sacral vertebræ. Clavicles flat plates with parallel anterior and posterior margins. A ventral armour of scutes. Primitively aquatic.

Anthracosaurus Hux. Lower Carboniferous, Scotland.

Pteroplax Hancock & Atthey. L.? Coal Measures, Northumberland.

Pholiderpeton Hux. M. Coal Measures, Yorkshire.

? *Erpetosuchus* * Moodie. U. Coal Measures, Kansas.

Family LOXOMMIDÆ, nov.

Embolomeri with triple occipital condyles and enlarged orbits. Post-cranial skeleton not known. ? No ventral armour.

Loxomma Hux. L. Carboniferous, Scotland.

"*Loxomma allmani.*" Lower and Middle Coal Measures, Lanarkshire, Fifeshire, Northumberland, Staffordshire.

Baphetes Owen. Coal Measures, Nova Scotia.

"*Loxomma bohemicum.*" L. Permian, Nýran, Bohemia.

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* Name preoccupied. E. T. Newton, 1893.

Family PHOLIDOGASTERIDÆ, nov.

Embolomeri showing a passage to Rachitomi? With clavicles expanded on the ventral surface. Ventral armour of scutes. (Secondarily aquatic?)

Pholidogaster Huxley. Lower Carboniferous, Scotland.

Family CRICOTIDÆ Cope.

Embolomeri with elongated skulls. Clavicles expanded on the ventral surface. Ventral armour of small scutes. (Secondarily aquatic?)

Cricotus Cope. Artinskian, Texas, and ? U. Coal Measures, Illinois.

Embolomeri incerta sedis.

Diplovertebron Fritsch. L. Permian, Bohemia.
Nummulosaurus ,, ,, ,,
Macromerium ,, ,, ,,
Spondylerpeton Moodie. U. Carboniferous, Illinois.

Grade **RACHITOMI** Cope.

Labyrinthodonts with ossified basioccipital and basisphenoid. Occipital condyle triple or double. Pterygoids usually with a medium-sized palatal part, interpterygoid vacuities of medium to large size. Pterygoids articulating with both parasphenoid and basisphenoid. Tabulars and dermo-supraoccipitals with occipital flanges. Paroccipital always visible from behind.

Vertebræ rachitomous, *i. e.*, with small paired pleurocentra and half-moon shaped intercentra.

Grade **STEREOSPONDYLI** Cope.

Labyrinthodonts with reduced basioccipital and basisphenoid. Occipital condyle double. Pterygoids with a reduced palatal ramus, interpterygoid vacuities large to very large. Pterygoids supported by the parasphenoid. Exoccipital meeting the occipital flange of the tabular so as to hide the paroccipital in an occipital view.

Vertebræ stereospondylous, *i. e.*, with very reduced or absent pleurocentra and enlarged intercentra.

I have discussed the classification of the grades Rachitomi and Stereospondyli in very great detail in a paper which will, I hope, soon be published; it is therefore unnecessary to reproduce the division into families on the present occasion.

Super-Order PHYLLOSPONDYLIA Credner.

Small, very highly specialised Batrachia with a roofed skull, palate with very widely open interpterygoid vacuities, palatines and lower jaw very reduced. Coracoid and pubis not ossified. Four-fingered hand. Ventral armour of small round scutes.

Family BRANCHIOSAURIDÆ Fritsch.

With the characters of the super-order.

Branchiosaurus Fritsch. Upper Coal Measures and Lower Permian, Bohemia, Germany, and France.

Micrerpeton Moodie. Coal Measures, Illinois.

Melanerpeton Fritsch. L. Permian, Bohemia and Saxony.

Pelosaurus Credner. „ Saxony and France.

? *Dawsonia* Fritsch. „ Bohemia.

Super-Order LEPOSPONDYLIA Zittel.

Small Batrachia with a roofed skull and lepospondylous vertebræ.

Very few members of the super-order are at all completely known, and these differ in many respects. In the structure of the skull and lower jaw *Batrachiderpeton* and *Diplocaulus* show clear resemblances to the Labyrinthodontia, perhaps only owing to a common descent from Crossopterygian fish.

Family NECTRIDIA Miall.

Lepospondyli with the posterior corners of the skull produced. Two occipital condyles. Palate with a small parasphenoid and small vacuities. Tail with long neural and hæmal spines, expanded and fluted at the ends. Accessory articulating facettes between the vertebræ.

Keraterpeton Hux. Coal Measures, Ireland and England.

Urocordylus Hux. „ „ „

Batrachiderpeton Hancock & Atthey. Coal Measures, England.

? *Scincosaurus* Fritsch. L. Permian, Bohemia.

? *Oestocephalus* Cope. Coal Measures, Ohio.

? *Ptyonius* Cope. „ „

? *Sauravus* Thevenin. U. Coal Measures, France.

? *Diceratosaurus* Jaekel. Coal Measures, Ohio.

? *Crossotelos* Case. L. Permian, Oklahoma.

Family DIPLOCAULIDÆ

Lepospondyli with enormously produced corners of the skull. Palate with a large parasphenoid and moderate-sized vacuities. Tail long, with well interlocked vertebræ.

Diplocaulus Cope. L. Permian, Texas; U. Carboniferous, Illinois.

Family AISTOPODIDÆ.

Legless Lepospondyls.

Dolichosoma Hux. U. Carboniferous, Ireland; and other forms not necessarily closely connected.

Batrachia incerta sedis.

Lysorophus (primitive Urodele ?); *Cardiocephalus*, *Gymnarthrus*, etc.

Class REPTILIA.

It is now impossible to give any definition of the class Reptilia which, whilst including all members of the group, will exclude all other Tetrapods. The essential feature of a reptile is that it can carry out the whole of its life-history on dry land, not producing a gill-breathing larva, and that it is not a mammal or a bird. Reptiles lay a shelled egg except in viviparous forms, in which the egg is hatched before it is laid.

Super-Order COTYLOSAURIA (Cope).

Reptiles with a roofed skull and plate-like pelvis. The members of this super-order are merely held together by these primitive characters, the typical forms also by many other common primitive reptilian characters lost by the advanced members of this group.

Order **Seymouriamorpha**, nov.

Cotylosaurs with a skull resembling in nearly all known details that of the Anthracosauridæ. Otic notches small, quadrate inclined backward. Tabulars and dermo-supraoccipitals on the skull roof, but with occipital flanges. Pro-otic reaching the skull roof. Inner ear widely open to the cranial cavity in the lateral wall of the cranium. Vertebræ with very heavy and expanded arches and very large intercentra.

Limbs very primitive, like those of the Rhachitomous amphibian *Eryops* in many features.

Seymouria Broili. Artinskian, Texas.

Order **Diadectomorpha**, nov.

Cotylosaurs with exaggerated laterally placed otic notches and a vertically placed quadrate.

Super-Family Diadectidæ Cope.

Diadectomorphs with a long low brain-cavity. Tabulars and interparietal turned down onto the occipital surface, closed post-temporal vacuities. Inner ear widely open to cranial cavity. Vertebræ with heavy neural arches. Limbs primitive.

Diadectes Cope. Artinskian, Texas.
Diadectoides Case. ,, ,,
Nothodon Marsh. ? U. Coal Measures, New Mexico.
Animasaurus Williston. ,, ,, ,,
? *Desmatodon* Case. ,, ,, Pennsylvania.
Diasparactus Case. ,, ,, New Mexico.
Chilonyx Cope. Artinskian, Texas.
? *Stephanospondylus* Geinitz & Deich. M. Rothliegende, Saxony.

Super-Family PARIASAURIDÆ Seeley.

Diadectomorphs with a long low brain-case. Tabulars and dermo-supraoccipitals on the dorsal surface. Large post-temporal vacuities. Otic notch secondarily obliterated. Inner ear separated from cranial cavity by bone.

Vertebræ with heavy neural arches. Pectoral limb advanced in the nearly vertical position of the fore arm in life. Pelvic girdle advanced in the expanded backwardly sloping ilium.

Pariasaurus Owen.	U. Permian, S. Africa.
Propappus Seeley.	,, ,,
Anthodon Owen.	,, ,,
Bradysaurus Watson.	M. Permian, ,,
Embrithosaurus Watson	,, ,,
Elginia E. T. Newton.	U. Permian, Scotland.
Pariasuchus Broom.	,, S. Africa.
? *Sclerosaurus* H. v. Meyer.	L. Trias, Switzerland.

Super-Family PROCOLOPHONIDÆ Seeley.

Diadectomorphs with a short high Sphenodon-like brain-case. Tabulars partly on the occipital surface.

Vertebræ with heavy neural arches.

Fore limb specialised in the loss of the screw-shaped glenoid cavity.

Procolophon Owen.	L. Trias, S. Africa.
Telerpeton Mantell.	M. Trias, Scotland.
Koiloskiosaurus v. Huene.	L. Trias, Germany.

Order **Capitorhinomorpha**, nov.

Cotylosaurs with an obliterated otic notch and vertically placed quadrates.

Super-Family CAPTORHINIDÆ.

Captorhinomorphs with short high brain-cavity, widened supraoccipital (inner ear placed low down?). Dermo-supraoccipitals on the occipital surface. Stapes perforate, with a very large foot-plate articulating with pro-otic, paroccipital, basisphenoid, and basioccipital, and distally reaching the quadrate.

Limbs primitive.

Fam. CAPTORHININÆ.

Captorhinus Cope.	Artinskian, Texas.
Labidosaurus ,,	,, ,,

? Fam. PARIOTICHIDÆ.

Pariotichus Cope.	Artinskian, Texas.
Isodectes ,,	,, ,,
Puercosaurus Williston.	Artinskian, New Mexico.

Super-Family LIMNOSCELIDÆ, nov.

Captorhinomorphs. Brain-case unknown. With primitive limbs, carpus and tarsus only partially ossified.

Limnoscelis Williston. U. Coal Measures, New Mexico.

Super-Family PANTYLIDÆ, nov.

Brain-case unknown.

With light neural arches and limbs.

Pantylus Cope. Artinskian, Texas.

Super-Order ANOMODONTIA Owen.

Reptiles with a single temporal vacuity. A short high brain-case with the inner ear placed low down. Supraoccipital very broad. "Stapes" articulating with the quadrate. Tabulars and dermo-supraoccipital on occipital surface. In typical forms the lower jaw laterally compressed and with a notched angular.

Derived from a common ancestor with Captorhinidæ.

Order **Caseasauria**, nov.

Doubtfully belonging to super-order.

Skull short, with a single laterally placed temporal fossa, surrounded by the postorbital, squamosal, ? quadratojugal and jugal.

Brain-case not well known but apparently considerably different from the normal type of the super-order. Stapes extending nearly to quadrate. Lower jaw showing a projection of the articular on the inner side and perhaps a lateral compression of the angular which may lead on to the typical superordinal arrangement.

Casea Williston. Artinskian, Texas.

? *Trispondylus* Williston. Artinskian, Texas.

Order **Pelycosauria.**

Anomodonts with the postorbital and squamosal meeting over the temporal fossa, with a screw-shaped glenoid cavity carried by scapula, coracoid, and precoracoid, and primitive limbs.

Super-Family POLIOSAURIDÆ Case.

Pelycosaurs with a straight tooth-row and undifferentiated dentition. A small supratemporal; stapes articulating with the pro-otic, paroccipital, basioccipital, and basisphenoid round the fenestra ovale only. Cervical neural arches usually heavy and with nearly horizontal zygapophysial facets.

Varanosaurus Broili. Artinskian, Texas.
Varanoops Williston. " "
? *Poliosaurus* Case. " "
Pœcilospondylus Case. " "
? *Mycterosaurus* Williston. " "

Super-Family OPHIACODONTIDÆ.

Pelycosaurs with a curved tooth-row and slightly differentiated dentition. A small supratemporal. Stapes articulating with the edges of the fenestra ovale and by a special head with the under surface of the paroccipital process. Cervical neural arches not heavy.

Deiopeus Cope.	Artinskian, Texas.
Theropleura Cope.	„ „
Ophiacodon Marsh.	U. Coal Measures, New Mexico.
? *Stereorachis* Gaudry.	L. Permian, France.

Super-Family SPHENACODONTIDÆ.

Pelycosaurs with a curved tooth-row and well-differentiated dentition.

Stapes of two parts, a small element articulating with the fenestra ovale and distally with a large element which articulates with the paroccipital process, the pterygoid and quadrate. A typical compressed and notched angular.

Family CLEPSYDROPIDÆ Cope.

Sphenacodontidæ with a carnivorous dentition and a pronounced step between the dentigerous edges of the premaxilla and maxilla.

Clepsydrops Cope.	Artinskian, Texas. Upper Coal Measures, Illinois.
Dimetrodon Cope.	Artinskian, Texas.
Sphenacodon Marsh.	„ New Mexico.
Tetraceratops Matthew.	„ Texas.
? "*Geosaurus cynodus*" Gervais.	L. Permian, France.

Family EDAPHOSAURIDÆ Cope.

Sphenacodontidæ with a powerful palatal dentition of small teeth.

Edaphosaurus Cope.	U. Coal Measures and L. Permian, Texas, New Mexico, Bohemia, Saxony, Urals.
Naosaurus Cope.	L. Permian, Texas.

Super-Family BOLOSAURIDÆ.

Systematic position very doubtful, but as the occiput seems to be of Anomodont type and the lower jaw is undoubtedly compressed and the angular apparently notched, they may be placed here.

Skull with large orbits and very short pre-orbital and temporal region, upper surface passing smoothly into the occiput. Temporal vacuity entirely on the side of skull and placed low down.

Bolosaurus Cope. Artinskian, Texas.
? *Glaucosaurus* Williston. Artinskian, Texas.
? *Palæohatteria* Credner. L. Permian, Saxony.

Pelycosaurs of undetermined position.

Arribasaurus Williston. U. Coal Measures, New Mexico.
Bathygnathus Leidy. Permian, Canada. (? Clepsydropid.)

Order **Deinocephalia** Seeley.

Anomodont reptiles, with unreduced quadrates. No supratemporal element. Postorbital and squamosal meeting above temporal fossa. The basicranium forming a deep wall below the condyle. Glenoid cavity supported solely by the scapula and coracoid in typical forms. Limbs modernised.

Super-Family TAPINOCEPHALIDÆ.

Deinocephalia with a short skull and short mouth.

Tapinocephalus	Owen.	M. Permian,	S. Africa.
Mormosaurus	Watson.	,,	,,
Pnigalion	Watson.	,,	,,
Lamiasaurus	Watson.	,,	,,
Struthiocephalus	Haughton.	,,	,,
Moschosaurus	,,	,,	,,
Moschops	Broom.	,,	,,
Moschognathus	Broom.	,,	,,
Taurops	,,	,,	,,
Eccasaurus	,,	,,	,,
Delphinognathus	Seeley.	,,	,,
Deuterosaurus	Eichwald.	Permian,	Russia.

etc.

Super-Family TITANOSUCHIDÆ.

Deinocephalia with an elongated mouth.

Titanosuchus	Owen.	M. Permian,	S. Africa
? *Rhopalodon*	Fischer.	,, ,,	Russia.
? *Cliorhizodon*	Twelvetrees.	,, ,,	,,
? *Dinosaurus*	Fischer.	,, ,,	,,

Order **Dromasauria.**

Anomodonts with very long slender limbs. Large orbits, short pre-orbital and temporal region, rounded dorsal contour of skull, and a **T**-shaped squamosal.

? descended from Bolosauridæ.

Galechirus	Broom.	M. Permian,	S. Africa.
Galepus	,,	,,	,,
Galeops	,,	,,	,,
? ***Palæohatteria***	Credner.	L. Permian,	Germany.

Order **Dicynodontia.**

Anomodonts with a reduced quadrate and quadratojugal. T-shaped squamosal without otic groove. Fenestra ovale carried down by a long process composed of basioccipital, basisphenoid, prootic, and paroccipital.

Scapula with acromion.

Glenoid cavity borne only on scapula and coracoid. Pelvis with a pubo-ischiac vacuity.

Dicynodon Owen.	M. and U. Permian,	S. Africa and Russia.
Tropidostoma Seeley.	U. ,,	,,
Endothiodon Owen.	M. Permian,	S. Africa.
Cryptocynodon Seeley.	U. Permian,	,,
Prodicynodon Broom.	,,	,,
Pristerodon Huxley.	,,	,,
Gordonia Newton.	,,	Scotland.
Geikia ,,	,,	,,
Kisticephalus Owen.	,,	S. Africa.
Dicælurodon Broom.	,,	,,
Taognathus ,,	,,	,,
Kannemeyeria Seeley.	M. Trias,	,,
Lystrosaurus Cope.	L. Trias,	,,
Eubrachiosaurus Williston.	M. Trias,	Wyoming.
Placerias Lucas.	M. Trias,	Arizona.

Order **Theriodontia** Owen.

Anomodonts with carnivorous specialisation and reduced quadrate and quadrato-jugal. Glenoid cavity on scapula and coracoid.

Sub-Order *GORGONOPSIA* Lydd.

Theriodonts with the parietal excluded from the temporal fossa. Palate with no suborbital vacuities.

Gorgonops Owen.	M. Permian,	S. Africa.
Scymnognathus Broom.	U. ,,	,,
Arctops Watson.	M. ,,	,,
Galesuchus Haughton.	M. ,,	,,
Scymnosaurus Broom.	M. ,,	,,
? *Cynodraco* Owen.	M. ? ,,	,,
? *Tigrisuchus* Owen.	U. ? ,,	,,
Ælurosaurus Owen.	M. ,,	,,
Arctognathus Broom.	U. ,,	,,
Inostransevia Amalitzki.	U. ,,	Russia.

Sub-Order *CYNODONTIA* Owen.

Theriodonts with a narrow intertemporal bar formed by the parietals. Secondary palate with no suborbital vacuities.

Fam. CYNOGNATHIDÆ.

Cynognathus	Seeley.	M. Trias,	S. Africa.
Diademodon	,,	,,	,,
Trirachodon	,,	,,	,,
Cynochampsa	Owen.	,,	,,

Fam. NYTHOSAURIDÆ.

Galesaurus	Owen.	M. Trias,	S. Africa.
Nythosaurus	,,	,,	,,

Sub-Order *THEROCEPHALIA* Broom.

Theriodonts with a narrow intertemporal bar formed mainly by the parietals. No secondary palate. Large suborbital vacuities.

Scylacosaurus	Broom.	M. Permian,	S. Africa.
Lycosaurus	,,	,,	,,
Alopecodon	,,	,,	,,
Hyænosuchus	,,	,,	,,
Pardosuchus	,,	,,	,,
		etc.	

Sub-Order *BAURIAMORPHA*.

Theriodonts with short temporal vacuities separated by the parietals. A secondary palate and large suborbital vacuities.

Bauria	Broom.	M. Trias,	S. Africa.
Microgomphodon	Seeley.	M. ,,	,,
Sesamodon	Broom.	? L. ,,	,,
Melinodon	Broom.	M. ,,	,,

Super-Order CHELONIA.

Reptiles with a roofed skull and the middle eight of the ten dorsal vertebræ provided with widened ribs, supporting a dermal armour.

Order **Eunotosauria**.

? if rightly referred.

Chelonia with costal plates not fused with the ribs and the pectoral and pelvic girdles not within the ribs.

Eunotosaurus Seeley. M. Permian, S. Africa.

Order **Testudinata**.

Chelonia with the pectoral and pelvic girdles within the dorsal ribs.

Family **PLEURODEIRA**.

Testudinates which withdraw the head sideways.

Family AMPHICHELYDIDÆ.

Proganochelys Baur.	U. Trias, Württemberg.
Proterochersys E. Fraas.	„ „

Super-Order SAUROPTERYGIA.

Aquatic or semi-aquatic reptiles with a single temporal vacuity. Neck long, the cervical ribs articulating solely with the centrum, dorsal ribs single-headed.

A single coracoidal element.

Pelvis with an obturator foramen.

Sub-Order *NOTHOSAURIA.*

Semi-aquatic Sauropterygia. Paroccipital expanded and reaching the squamosal, pterygoid, and quadrate so as to close the middle ear behind.

Radius and ulna, tibia and fibula long bones.

Nothosaurus Münster.	L. & M. Trias, Germany.
Cymatosaurus Fritsch.	M. Trias, Germany.
	etc.

Sub-Order *PLACODONTA.*

Sauropterygia with paroccipital not articulating with pterygoid and quadrate. Massive crushing teeth on the palatines. (Body with a heavy armour of bony scutes.) Limb-bones long.

Placodus Agassiz.	M. Trias, Germany.
Cyamodus „	„ „
Placochelys Jaekel.	„ Hungary.

Order **Thalattosauria** Merriam.

Aquatic reptiles with a single lateral temporal vacuity. A supratemporal present. A single coracoidal element. Occipital region of skull unknown. Humerus twisted with expanded ends.

Thalattosaurus *Nectosaurus*	Merriam. M. Trias, California and Nevada.

Order **Ichthyosauria.**

Aquatic reptiles with a single temporal vacuity, very large orbits, and much elongated premaxillæ.

Basisphenoid without definite basipterygoid processes, pterygoids underlying much of its lower surface and that of the basioccipital. Neck short.

Family MIXOSAURIDÆ.

Ichthyosauria with relatively small orbits and short rostrum. Upper end of the scapula expanded. Pubis and ischium broad.

Epipodials long and separated. Caudal region not much deflected.

Fam. MIXOSAURINÆ. With five digits.

Mixosaurus. M. Trias, Italy, Germany, Spitzbergen, W. N. America.

Fam. SHASTASAURINÆ. Narrow paddles with three or four digits.

Cymbospondylus.	M. Trias, Nevada.
Toretocnemus.	
Merriamia.	
Shastasaurus.	
Delphinosaurus.	

Super-Order ARCHOSAURIA.

Reptiles with a skull with two temporal openings. Brain-case much narrowed between the ears, usually surrounded by bone in advance of the prootic. Paroccipital process antero-posteriorly compressed and long, with the fenestra ovale opening on its lower edge.

A single coracoidal element.

Order **Thecodontia.**

Primitive Archosaurians with clavicles and an interclavicle. Pelvis "plate like."

Family "EOSUCHIDÆ."

Thecodonts with intercentra throughout the column.

"*Eosuchus*" Watson.	U. Permian, S. Africa.
Youngina Broom.	,, ,,

Family ERYTHROSUCHIDÆ, nov.

Very large semiaquatic Thecodonts with a twisted humerus with much expanded ends. Anterior margin of pubis suddenly deflected. Feeble dorsal armour.

Erythrosuchus Broom. M. Trias, S. Africa.

Family PHYTOSAURIDÆ McGregor.

Large Thecodonts, with an elongated rostrum formed mainly by the premaxilla. Dorsal and ventral scutes.

Mesorhinus **Jaekel.**	**L. Trias, Germany.**
Palæorhinus **Williston.**	**M. ? Trias, Wyoming.**
Phytosaurus **Jaeger.**	**U. Trias, Württemberg and U.S.A.**
Mystriosuchus **Fraas.**	**,, ,,**
Rhytidodon **Emmons.**	**,, U.S.A.**
?*Stagonolepis* **Agassiz.**	**M. Trias, Scotland.**

Family ORNITHOSUCHIDÆ v. Huene.

Small, slightly built Thecodonts. Pointed skull without produced rostrum. Pubis and ischium much produced.

Hinder limbs longer than the fore.

? Directly ancestral to Theropodous Deinosaurs.

Ornithosuchus E. T. Newton. M. Trias, Scotland.
Euparkeria Broom. „ S. Africa.
Scleromochlus A. S. Woodward. „ Scotland.
Sphenosuchus Haughton. U. Trias, S. Africa.

Family AETOSAURIDÆ Baur.

Small Thecodonts with a pointed skull without rostrum, pubis and ischium short. Hind limbs not greatly larger than the fore. A very heavy dorsal and ventral armour.

Aetosaurus Fraas. U. Trias, Wurttemberg.
?*Dyoplax* „ „ „
?*Stegomus* Marsh. „ U.S.A.
?*Notochampsa* Broom. „ S. Africa.

Family HOWESIIDÆ, nov.

? Thecodonts with several rows of teeth in the maxilla.

Howesia Broom. M. Trias, S. Africa.
?*Mesosuchus* Watson. „ „
??*Proterosuchus* Broom. „ „

Family ERPETOSUCHIDÆ, nov.

Small Thecodonts with a pear-shaped skull, not very elongated rostrum. Palate incipiently secondary, with the posterior nares in a deep groove.

? Ancestral to the Crocodilia.

Erpetosuchus E. T. Newton. M. Trias, Scotland.

Order **Saurischia** Seeley.

Archosauria with the astragalus very closely and immovably articulated with the tibia. Pelvis with the pubis and ischia long and projecting downward, usually with an ischio-pubic vacuity.

Thecodontosaurus Riley & Stutchbury. U. Trias, Somersetshire, Swabia, S. Africa, Queensland; and very many forms representing numerous families, defined especially by v. Huene.

Order **Rhynchocephalia** Günth.

Reptiles with a two-arched skull, a short, high brain-case not ossified in advance of the prootic, and large fenestra ovale. Teeth on the dentary biting into a groove between the maxillary and palatine teeth.

Family Rhynchosauridæ.

With plate-like pelvis.

Rhynchosaurus Owen. U. Trias, England.
Hyperodapedon Hux. M. & U. Trias, England, Scotland, India.
Stenometopon Boulenger. M. Trias, Scotland.
?*Palacrodon* Broom. M. Trias, S. Africa.

Order **Proganosauria** Baur.

Aquatic reptiles with long tails. Skulls elongated. Vertebræ with small notochordal centra and very heavy arches and no intercentra. A single coracoidal element, five distal carpals and tarsals. Pelvis plate-like.

Mesosaurus Gervais. L. ? Permian, S. Africa, Brazil.
Noteosaurus Broom. ,, S. Africa.
Stereosternum Cope. ,, Brazil.

Order **Protorosauria** Seeley.

Lightly built reptiles with pointed skulls and a single temporal vacuity. A single coracoidal element and a plate-like pubis.

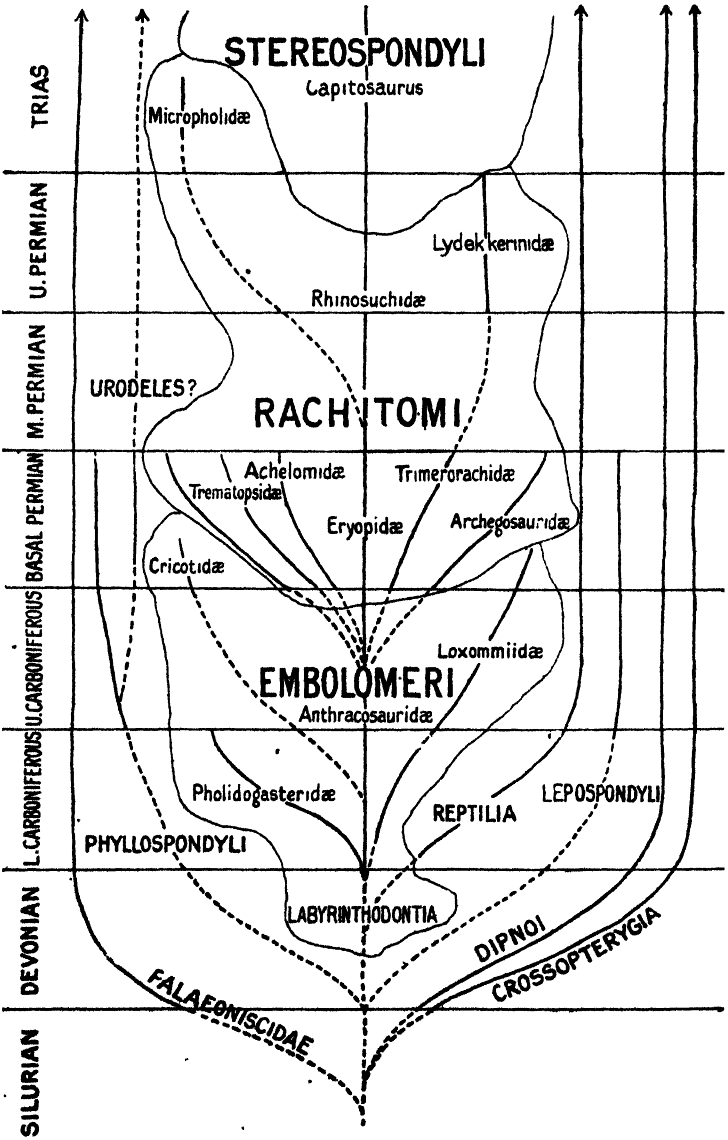
There is not the slightest evidence that the series of small Palaeozoic reptiles listed below are related to one another. Prof. Williston believes *Araeoscelis* to be related to the lizard ancestry. *Broomia* may also have affinities with the Squamata. *Adelosaurus* may be related to the Rhynchocephalia.

?*Protorosaurus* Meyer. U. Permian, Germany and England.
? { *Araeoscelis* Williston. Artinskian, Texas.
  { *Kadaliosaurus* Credner. L. Permian, Saxony.
? { *Broomia* Watson. M. Permian, S. Africa.
  { *Heleosaurus* Broom. ,, ,,
  { *Heliophilus* .. ,, ,,
?*Adelosaurus* Watson. U. Permian, England.
?*Aphelosaurus* Gervais. L. Permian, Autun.

Notes on the Amphibian Classification.

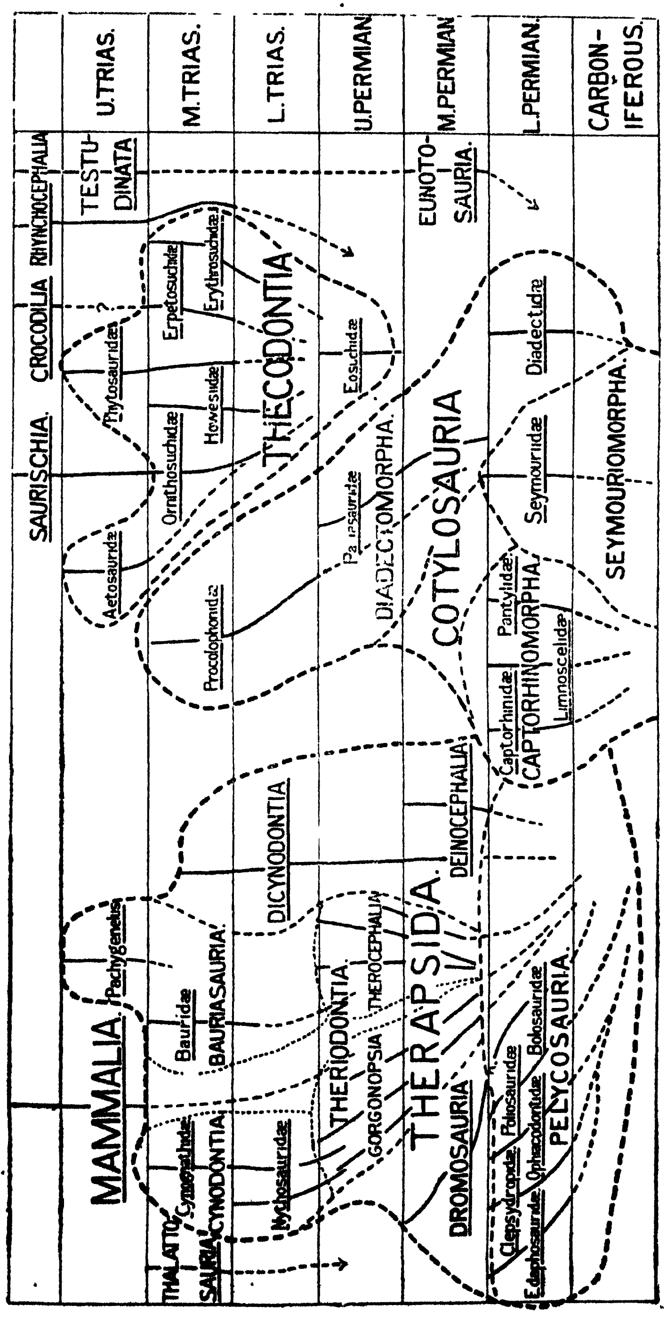
The superordinal separation of the Labyrinthodontia, Phyllospondylia, and Lepospondylia is based on the fact that the early members of these groups differ from one another as much as do their ultimate descendants, despite the fact that in a number of characters such as the gradual development of large interpterygoid vacuities, the replacement of basipterygoid processes with definite articulating surfaces by expansions of the posterior end of the parasphenoid with which the pterygoids are suturally united, and the loss of a finger in the hand, the course of evolutionary change is the same in the first and last group. The structure of the skull and lower jaw is known to be similar in

Text-figure 1.



Phylogenetic tree illustrating the relations of the early Amphibia, each group being placed in its correct time.

Text-figure 2.



Tree illustrating the Phylogeny of the early Reptilia.

the Labyrinthodontia and Lepospondylia, but the resemblance may easily be due to inheritance from common ancestors amongst the Crossopterygian fish.

The ordinal division of the Labyrinthodontia marks three stages in the evolution of that group. It is founded primarily on the skull, which becomes more and more depressed, the basioccipital and basisphenoid being gradually reduced from the quite large bones they are in *Pteroplax* to the small slightly ossified tracts lying on the parasphenoid which represent them in Stereospondyls. The development of the vertebral column is used as a check on this classification.

Notes on the Reptilian Classification.

The super-order Cotylosauria is retained simply because of its use as a dumping-ground for those primitive reptiles which retain a roofed skull. The orders are also probably somewhat unnatural groups, and it would perhaps have been more satisfactory to raise the super-families to ordinal rank.

The real classification, *i. e.* that into families, is founded as far as possible on the characters of the brain-case, which have been discussed by me in a series of papers.

The separation of the super-order Anomodontia is founded on its very characteristic brain-case, and for the typical forms on the equally characteristic lower jaw.

The remarkable animal *Casea* is obviously ordinally different from all other well-known forms, its position in the super-order Anomodontia is very doubtful, but it is not improbable that it represents a very early offshoot from this stock.

The order Pelycosauria is referred to the super-order Anomodontia with certainty; in *Dimetrodon* the brain-case and lower jaw are absolutely typical, and the other forms included are obviously allied to this type by the whole of their structure.

The super-family division is founded on differences in the stapedial articulation with the brain-case, which in the three suborders seem to form a morphological series.

The order seems to be self-contained, culminating in *Dimetrodon* and *Edaphosaurus*, towards which the other types lead. At the same time the trend of evolutionary change in the brain-case is the same as that which, continued in later times by the South-African forms, leads up to the mammals.

The super-family Bolosauridæ is founded for very badly known reptiles, which it might perhaps have been wiser to leave as Anomodontia incerta sedis. The position of the super-family in the super-order depends mainly on the badly preserved lower jaw.

The order Deinocephalia is certainly a member of the super-order, having the typical brain-case and lower jaw. It is distinguished from the Pelycosaurs by its advanced limbs, shown most clearly in the loss of the screw-shaped articular surface of the head of the humerus, and the corresponding restriction of the glenoid cavity to the scapula and posterior coracoidal element alone.

It is separated from other Anomodonts with advanced limbs by the retention of the large quadrate. The mode of articulation of the stapes shows that it cannot have been derived from any Pelycosaur more advanced than a Poliosaurid.

The order Dromosauria is referred to the super-order by its lower jaw and occiput. It is distinguished from all other South-African types by the short face, very large orbits, slender limbs, and long tail.

Palæohatteria is only placed here provisionally; it is certainly an Anomodont, and in the structure of its temporal region very strongly recalls *Galepus*. The absence of the posterior coracoidal element may only mean that, as in *Varanoops*, it is unossified, although present as a cartilage.

It will possibly be found, when fuller knowledge of *Bolosaurus* becomes available, that that type is really allied to the Dromosaurs, and that the two orders should be combined.

The order Dicynodontia includes the first known and typical Anomodonts. The order is a very compact group, thoroughly distinct from all others and of uncertain derivation, perhaps from the Deinocephalian stock.

The order Theriodontia includes many very diverse animals, still known almost wholly from skulls. Its members are held together by the presence of a reduced quadrate in all of them and by a well differentiated carnivorous dentition.

The suborder Gorgonopsida appears to be ancestral to the Cynodonts, the Therocephalia to the Bauriamorpha, and it is probable that other lines will be distinguished. Each suborder certainly contains many families, but in the absence of detailed knowledge of the skull and of all knowledge of the post-cranial skeleton in most forms, it seems at present useless to found families on the dentition.

I have recently discussed at length the relations of *Eunotosaurus* to the Chelonia; if rightly referred, it is so much more primitive than any other Chelonian that ordinal separation seems justified.

The various animals included in the Sauropterygia differ so widely amongst themselves, and the whole group is so distinct from all others, that its ordinal rank is unquestionable.

Merriam's quite distinct order Thalattosauria is still rather incompletely known, but its members certainly have only a single arch and the temporal region of the skull is reminiscent of the early Pelycosaurs.

The Ichthyosaurs form a very compact group, whose origin is quite unknown.

The inclusion of the two arched reptiles in one super-order is now commonly accepted. I have excluded the Rhynchocephalia from the super-order because of certain differences in the brain-case, which may, however, be due to the small size of *Sphenodon*, in which alone is the region known. The exclusion is really for the purpose of drawing attention to the extreme smallness of our knowledge of early two-arched reptiles.

The small aquatic *Mesosaurus* and *Stereosternum* are still unrepresented by well-preserved skulls. They seem to be definitely ordinally distinct, but their affinities are quite obscure.

Finally, the order Protorosauria is retained merely because it is already in existence. Included in it is a series of small Permian reptiles which resemble one another in having slender limbs and a single coracoidal element. There is no evidence that these animals are in reality in any way related.

In this classification I have refrained from throwing weight on the peculiarly modified 5th metatarsal which occurs in Chelonia, Rhynchocephalia, Thecodonts, Crocodiles, Deinosaurs, and Squamates, because it is difficult to believe that all these forms can have been derived from the same advanced Cotylosaurian ancestor. It is perhaps an arboreal adaptation, which may have originated separately. Possibly the broadened ribs of *Eunotosaurus*, which recall those of sloths, are also to some extent an arboreal adaptation.

This classification is on the whole consciously conservative, but contains many new features, chiefly in the definitions and the super-ordinal grouping. An attempt has been made to make the structural differences separating orders approximate, having regard to the total variation, to those used in separating the orders of mammals, but in many cases suborders should perhaps be raised to ordinal rank. Super-orders are used to group together orders which seem to have had a common origin.

11. Notes on some of the Viscera of an Okapi (*Okapia johnstoni* Sclater). By R. H. Burne, M.A., F.Z.S.

[Received March 9, 1917: Read April 3, 1917.]

(Text-figures 1–23.)

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During the winter of 1915–1916 certain parts of the viscera of an Okapi were sent by Dr. Cuthbert Christy to the Royal College of Surgeons for investigation.

They included the tongue and the soft parts of the anterior end of the throat, the contents of the thorax, the stomach, and the colic coil of the intestine.

A superficial examination revealed, as was to be expected, a general similarity to the corresponding viscera of the Domestic Ruminants, but a more detailed comparison with other genera[*] made it clear that underlying this general Ruminant type of structure were many small and individually unobtrusive peculiarities that pointed definitely to a very close relationship between the Okapi and the Giraffe.

The Tongue (text-figs. 1 & 2).

The tongue of the Okapi, though of the Ruminant type, resembles most nearly that of the Giraffe, both by reason of its great length and slenderness (it measures some 14 in. in length by from 1½ to 2 in. in breadth) and its sharp pointed extremity and smooth base. It is thus distinguished from the tongues of Antelopes and Deer, the tip of which is as a rule either blunt or broadly spatulate, and in which the surface of the elevated base or intermolar fixed portion is covered with large fleshy papillæ.

It is manifestly difficult to state with accuracy the relative measurements of a tongue or the proportions that its different parts bear to one another, as they depend on its degree of extension; but after comparison with numerous tongues of Antelopes and other Ruminants, both fresh and preserved, it seems fairly clear that the free part of the Okapi's tongue is considerably more developed relative to the base than is that of other Ruminants, with the exception of the Giraffe.

The form and disposition of the various papillæ upon the surface of the tongue differ little from those in the Giraffe, and are

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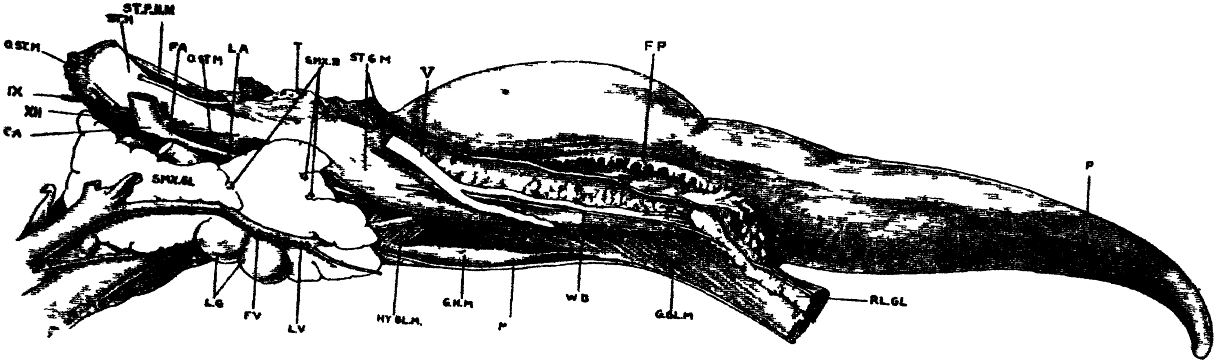
[*] I am indebted to the Zoological Society for material for use in the comparative study of the throat and tongue,—Giraffe, Crowned Duiker, Indian Antelope, Black Buck, Sœmmering's Gazelle, and *Gazella rufifrons*.

Use was also made of preparations in the Royal College of Surgeons Collection of the tongue and larynx of many Ruminants, of the heart and lungs of Ox, Sheep, and Goat, and of the stomach of a young Giraffe and of several Antelopes and the Domestic Ruminants.

Text figure 1



Lateral view of the tongue and pharynx of *Okapia johnstoni*.

c.a, carotid artery, ***cr th m***, cricothyroid muscle, *fa*, facial artery, *fp*, fringe of lateral lingual papillæ, ***fv***, facial vein, ***g.gl.m***, genioglossus muscle, ***g h m***, geniohyoid muscle, ***h gl m***, hyoglossus muscle, *l a*, lingual artery, *l g*, lymph-glands; ***l v***, lingual veins, ***m m***, mylohyoid muscle, *o st m*, occipito-styloideus muscle, *p*, limit of pigmented area of tongue, ***r l gl***, retro-lingual gland, ***sl gl***, sublingual gland, ***s mx gl***, submaxillary gland, ***s mx l***, collecting ducts of submaxillary gland, ***st g m***, styloglossus muscle, ***st h***, stylohyal, ***s h m***, sterno hyoid muscle, ***st hy m***, stylohyoid muscle, ***st.ph m***, stylo-pharyngeal muscle, ***st th m***, sterno thyroid muscle, ***t***, tonsil, ***W d***, Wharton's duct

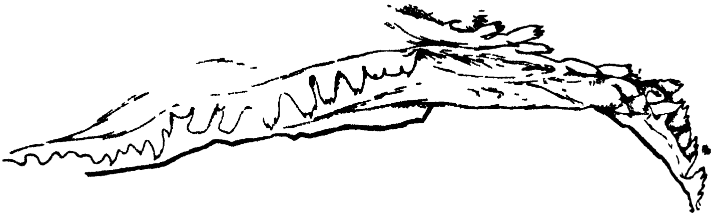
V. Lingual nerve. IX Glosso-pharyngeal nerve. XII Hypoglossal nerve characteristically Ruminant. The dorsal surface and sides are clothed with a close layer of sharp-pointed filiform papillæ which are more or less cornified, particularly so upon a central area of the dorsal surface close behind the tip, where they form a patch of small horny recurved spines.

Fungiform papillæ are scattered sparsely all over those parts of the free extremity and base that are coated with filiform papillæ except, as one frequently sees among Ruminants, along the central line of the dorsum.

Circumvallate papillæ, to the number of 15 or so on either side, are arranged in two indistinct irregular rows far back upon each side of the base of the tongue. This is the normal Ruminant position and arrangement, but the indistinctness of the individual papillæ and of the limits of the group as a whole recall more particularly the condition in the Giraffe.

There are no foliate papillæ, and, as previously mentioned, the base of the tongue is smooth, as in the Giraffe.

Text-figure 2.



Lingual papillæ of *Okapia johnstoni*

In a large number of Ruminants (nearly all Antelopes, the Giraffe, some Sheep and Oxen, but not in Deer) parts of the free extremity of the tongue are deeply pigmented. This also is the case in the Okapi, where the pigmented area includes the extreme tip of the tongue and extends some way backwards on either lateral surface, gradually fading away (text fig. 1, *p.*).

In the valley between the base of the tongue and the gums, there is in all Ruminants a fold of mucous membrane fringed by a number of sharp-pointed papillæ similar in character and probably also in function to the conical papillæ that clothe the inner surface of the cheeks.

A similar fringe of fleshy papillæ lies beside the base of the tongue of the Okapi; but whereas in all the other Ruminants examined the papillæ are simple conical processes flattened from side to side and usually recurved like the thorns of a rose, in the Okapi they have quite a peculiar shape, being swollen and blunt with two three or more short, sharp horny spines projecting from their rounded free extremities (text-fig. 2).

The Muscles of the Tongue and Pharynx.

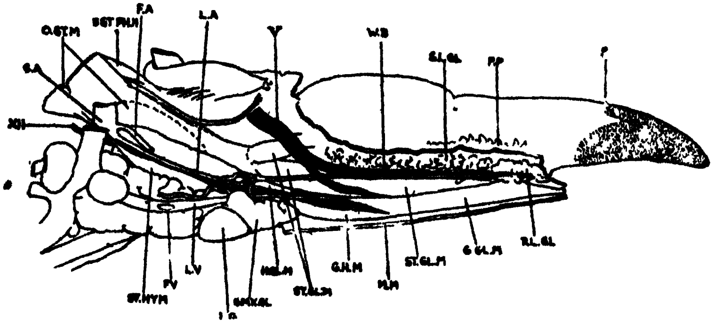
The muscles of the tongue conform in general to the common Ruminant type, but in the details of their arrangement and individual development disclose more points of agreement with the Giraffe than with any of the other Ruminants examined.

A comparison of the accompanying figures (figs. 1, 3, 4, 5, 6) shows more readily than a verbal description how close the similarity between the Okapi and Giraffe in respect of these muscles is. Attention may, however, be drawn to the following particulars.

Digastric, Mylohyoid, Geniohyoid, and Genioglossus Muscles.

Blending of the various muscles in the floor of the mouth to a varying degree is typical of Ruminants in general. In the majority, if not in all genera, the anterior belly of the digastric muscle and the mylohyoid are so closely united that where they blend in the superficial sheet of the mylohyoid it is impossible to distinguish the one from the other. The deeper muscles (geniohyoid and genioglossus) are, as a rule, more independent. Generally the former has a weak fibrous attachment along the central line of the mylohyoid, and very occasionally (e. g. *Antilope cervicapra*) it unites with the genioglossus close up to the symphysis menti, but as a rule it is a well-developed paired muscle independent of its neighbours.

Text-figure 3.

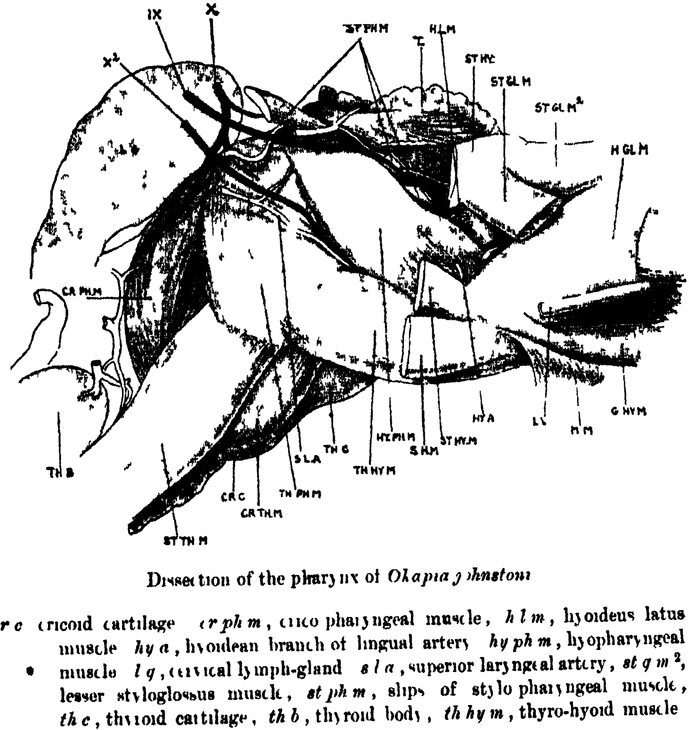


Outline of the tongue and pharynx of a Giraffe, for comparison with text-fig. 1. Lettering as in text-fig. 1.

In the Okapi and Giraffe, not only is the association of the digastric and mylohyoid peculiarly intimate, but there is also a very close fibrous union between the deep layer of the mylohyoid and the geniohyoid and a blending of the geniohyoid and genioglossus. The geniohyoid is also very much reduced in both these genera, and can only with difficulty be separated into its two component halves.

The condition is shown in text figs 1 and 3 It will be noticed that the belly of the geniohyoid extends only about halfway from the hyoid to the symphysis menti, and is continued upon the ventral surface of the genioglossus as a flat tendon from which a large part of the latter muscle arises.

Text-figure 4



Dissection of the pharynx of *Okapia johnstoni*

cr c cricoid cartilage *cr ph m*, crico pharyngeal muscle, *h l m*, hyoideus latus muscle *hy a*, hyoidean branch of lingual artery *hy ph m*, hyopharyngeal muscle *l g*, cervical lymph-gland *s l a*, superior laryngeal artery, *st g m* ^{2}, lesser styloglossus muscle, *st ph m*, slips of stylo pharyngeal muscle, *th c*, thyroid cartilage, *th b*, thyroid body, *th hy m*, thyro-hyoid muscle *th ph m*, thyro-pharyngeal muscle

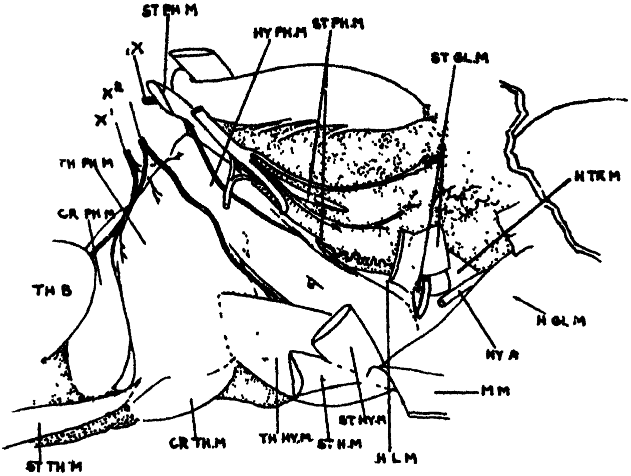
X¹ Pharyngeal branches of vagus X² Superior laryngeal branch of vagus

Other lettering as in text fig 1

Stylohyoid Muscle.

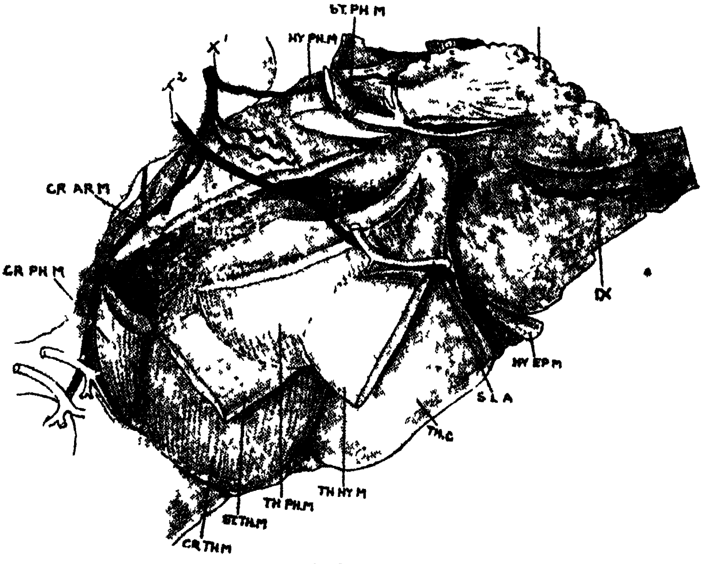
The round tendon of origin of this muscle differs a good deal in length in different genera of Ruminants. It is relatively short in Antelopes, considerably longer in the Okapi and Sheep, and longer again, though not by much, in the Giraffe.

Text-figure 5.



Outline of the pharynx of a Giraffe, for comparison with text-fig. 4. *h.tr.m.*, hyoideus transversus muscle. Other lettering as in text-fig. 4.

Text-figure 6.



Superficial dissection of the larynx of *Okapia johnstoni*.

cr.ar.m., crico-arytænoid muscle; *cr.ph.m.*, crico-pharyngeal muscle; *cr.th.m.*, crico-thyroid muscle; *hy.ep.m.*, hyo-epiglottidean muscle; *hy.ph.m.*, hyo-pharyngeal muscle; *s.l.a.*, superior laryngeal artery; *st.ph.m.*, stylo-pharyngeal muscle; *t.*, tonsil; *th.c.*, thyroid cartilage; *th.ph.m.*, thyro-pharyngeal muscle.
IX. Glosso-pharyngeal nerve. X¹. Pharyngeal branches of vagus. X². Superior laryngeal nerve.

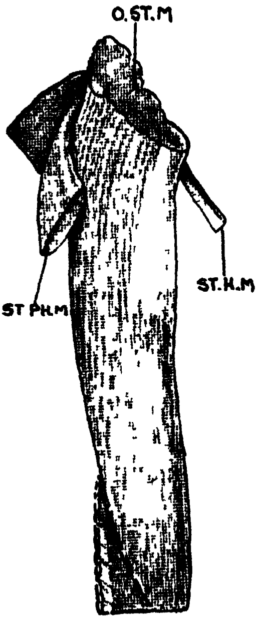
Occipito-styloideus (text-figs. 7, 8, 9, *o.st.m.*).

This muscle is peculiar to Ungulates, and extends from the styloid process of the occipital to the upper portion of the styloid bone.

In the Giraffe and Okapi it was far larger than in any of the other Ruminants examined (Antelopes and Sheep), and offers in these two genera a striking contrast to the same muscle in Antelopes, particularly as regards the area of the styloid bone covered by its insertion.

In connection with the insertion of this muscle it should be noted that the styloid bone of the Giraffe and Okapi differs markedly from that of other Ruminants in the form of its upper extremity (text-fig. 10).

Text figure 7.



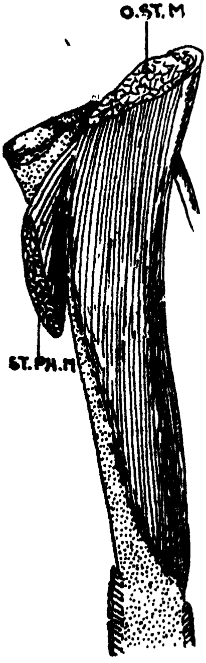
The upper end of the stylohyal of *Okapia johnstoni*, inner surface, showing the insertion of the occipito-styloideus muscle.

o.st.m., occipito-styloideus muscle; *st.h.m.*, tendon of stylohyoid muscle; *st.ph.m.*, stylo-pharyngeal muscle.

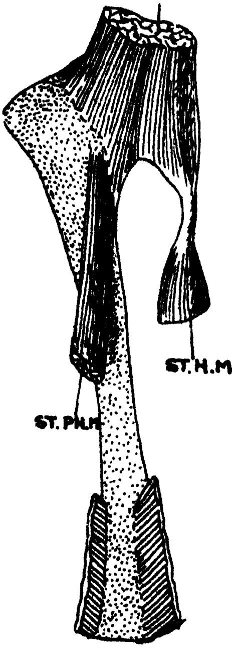
In Ruminants in general, the posterior margin of this bone, close to its upper end, is produced to form a prominent angular process, to the tip of which is attached the tendon of the stylohyoid muscle. This process stands out more or less transversely to the length of the bone and shows a tendency to a downward curve, forming in some Antelopes (text-fig. 10, B) a veritable hook, and in all cases offers a very broad surface for the insertion of the occipito-styloideus muscle.

In the Giraffe and Okapi (text-fig. 10, A) and in the Camels and the Perissodactyl Ungulates the process is relatively small, and is directed upwards, forming a simple swelling or tuberosity of the upper end of the styloid bone.

Text-figure 8.



Text-figure 9.



Text-fig. 8.—The stylohyal of a Giraffe, showing the occipito-styloideus muscle.

Text-fig. 9.—The stylohyal of Sœmmering's Gazelle, showing the occipito-styloideus.

Lettering as in text-fig. 7.

Salivary Glands.

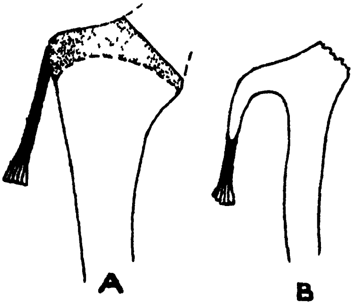
The submaxillary gland (text-figs. 1, 3, *smx.gl.*) is similar in position, form, and relative size in the Giraffe and Okapi, and is closely comparable also to the same gland in Antelopes and Domestic Ruminants.

In the Giraffe and Okapi the gland gives off two main tributary ducts, one from its posterior and one from its anterior end. The parts drained by these two collecting ducts can be readily and completely separated from one another in the Giraffe, but this is not the case in the Okapi.

The two tributary ducts unite in the Giraffe (the junction was destroyed in the Okapi) close in front of the gland to form a single Wharton's duct (text-fig. 3, *Wd.*), and there is no reason to think that the separate lobule drained by the anterior tributary is anything but a part of the submaxillary gland, for the retrolingual gland, which at first sight it might be supposed to be, is represented in Ruminants, including the Okapi and Giraffe, by a mass of gland-tissue surrounding the anterior extremity of Wharton's duct close behind the symphysis of the jaw, between the origin of the genioglossus muscle and the sublingual mucous membrane (text-figs. 1, 3, *rl.gl.*).

The sublingual gland calls for no comment. The parotid gland had been removed with the skin.

Text-figure 10.



Upper end of stylohyal of (A) *Okapia* and (B) Sœmmerring's Gazelle

The Blood-vessels of the Tongue (text-figs. 11, 12, 13).

In his description of the anatomy of the Giraffe, Owen* mentions a peculiar plexiform arrangement of the veins close in front of the body of the hyoid bone. In this position there is generally among Ruminants a large venous anastomosis uniting the lingual veins of either side. This anastomosis was strongly developed in the Giraffe's tongue (text-fig. 11, *v.a.*) dissected for comparison with that of the Okapi, and in front of it, upon the left side (text-fig. 11, *v.pl.*), there was some slight branching and reunion of the veins, suggesting the plexus mentioned by Owen. There was no indication of a plexus in the Okapi (text-fig. 12).

Posteriorly, the lingual vein passes through the substance of the submaxillary gland, and where it emerges again to the surface receives the facial vein (text-fig. 1, *f.v.*). At this spot lies a very definite lymph-gland, which in the Giraffe lies embedded in the substance of the salivary gland, and by its dark colour forms a very striking object when the surface of the gland is exposed.

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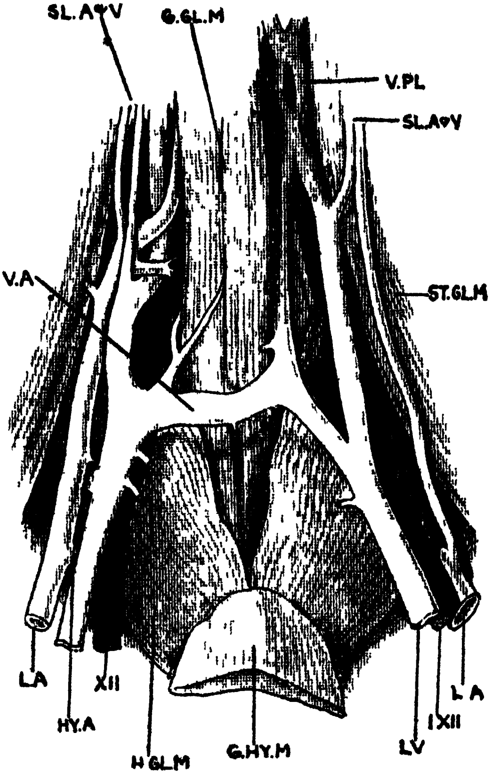
* Owen, Trans. Zool. Soc. vol. ii. 1841, p. 223.

In the Okapi, Antelopes, and Sheep this lymph-gland is not so deeply embedded as in the Giraffe, and in the Okapi (text-fig. 1, *l.g.*) consists of two globular masses separated from the submaxillary gland by a capsule of fibrous tissue.

Text-figure 11.



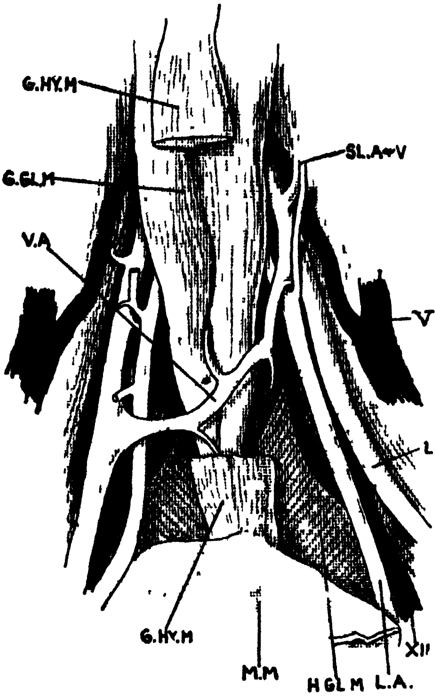
Blood-vessels at the root of the tongue of a Giraffe.

g.gl.m., genioglossus muscle; *g.hy.m.*, geniohyoid muscle; *h.gl.m.*, hyoglossus muscle; *hy.a.*, hyoidean branch of lingual artery; *l.a.*, lingual artery; *l.v.*, lingual vein; *sl.a.* & *v.*, sublingual artery and vein; *st.gl.m.*, styloglossus muscle; *v.a.*, venous anastomosis; *v.pl.*, venous plexus.
XII. Hypoglossal nerve.

The lingual arteries of the Okapi and Giraffe agree in many particulars and show several, though small, differences from those of Antelopes.

In both, the lingual artery arises from the carotid independently of the facial (text-figs. 1, 3, *f.a.*), as it is stated to do normally in the Sheep* and Goat, and occasionally in the Ox. In Antelopes, on the other hand, a common trunk (the arteria maxillaris externa) intervenes between the carotid and the lingual and facial arteries, dividing to form these two arteries about the middle of the submaxillary gland.

Text-figure 12.



Blood-vessels at the root of the tongue of *Okapia johnstoni*
m.m., mylohyoid muscle turned back.
Other lettering as in text-fig. 11

In passing the hyoid region of the tongue, the main trunk of the lingual artery may lie either deep or superficial to the hyoglossus muscle. In the Antelopes (text-fig. 13, *l.a.*) and Sheep it lies deep to this muscle, and in this position forms in the Antelopes a strong anastomosis (text-fig. 13, *a.a*) with its fellow of the opposite side, from which are given off the continuation of the main lingual artery, the sublingual artery, and branches to the muscles of the hyoid region.

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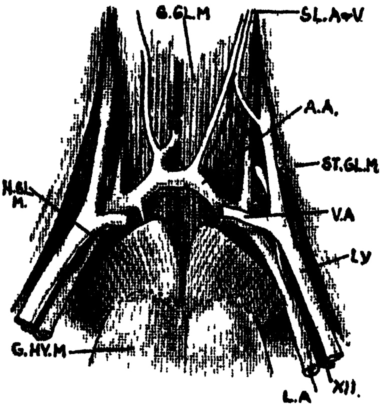
* In the Sheep dissected it was given off from an external maxillary trunk as in the Antelopes.

In the Okapi (text-fig. 12) and on one side in the Giraffe (text-fig. 11), the lingual arteries, after giving off a large branch to the hyoid region, passed superficially to the hyoglossus muscle, and in neither case was there any anastomosis between the vessels in this region. Nor was I able to trace in either of these genera the large connection between the lingual arteries at the commencement of the free portion of the tongue described by Owen in the Giraffe.

On the other hand, I can corroborate the fact mentioned by Owen that in the Giraffe the left lingual artery greatly exceeds the right in size (text-fig. 11), and carries practically the whole blood-supply to the free part of the tongue.

Text-figure 13.



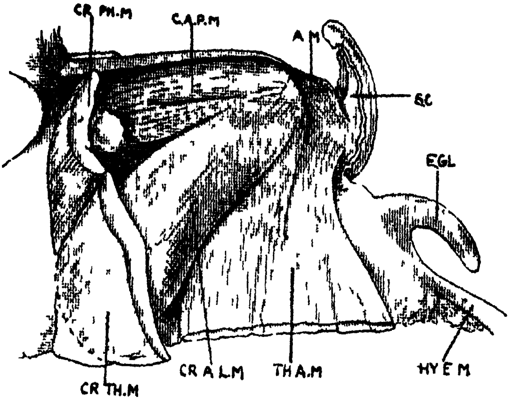
Blood-vessels at the root of the tongue of an Indian Antelope
a.a., anastomosis of the lingual arteries.
Other lettering as in text-fig. 11.

This is not, however, the case in the Okapi or among Antelopes and Sheep. In them the two lingual arteries are of equal size, but it should be noted that in the Okapi the left artery divides at the commencement of the free part of the tongue into a large ventral and a small dorsal branch, and thus provides the chief source of supply to the ventral parts of the extremity of the tongue, as it does in the Giraffe, the dorsal parts being supplied by the right artery and the smaller branch of the left.

The Larynx (text-figs. 14, 15, 16).

The larynx of the Okapi presents a remarkably close resemblance to that of the Giraffe, and by its structure suggests that the animal, like the Giraffe, is practically mute. In general it

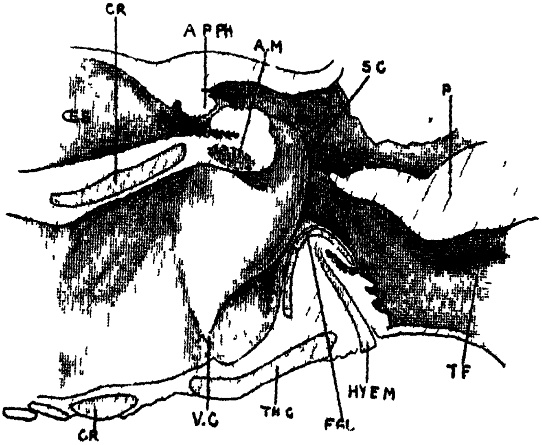
Text-figure 14.



Muscles of the larynx of *Okapia johnstoni*

a.m., arytenoideus muscle; *c.a.l.m.*, crico-arytenoideus lateralis muscle; *c.a.p.m.*, crico-arytenoideus posticus muscle; *c.ph.m.*, crico-pharyngeal muscle; *c.th.m.*, crico-thyroideus muscle; *e.gl.*, epiglottis; *hy.e.m.*, hyo-epiglottidean muscle; *th.a.m.*, thyro-arytenoideus muscles; *s.c.*, cartilage of Santorini.

Text-figure 15.



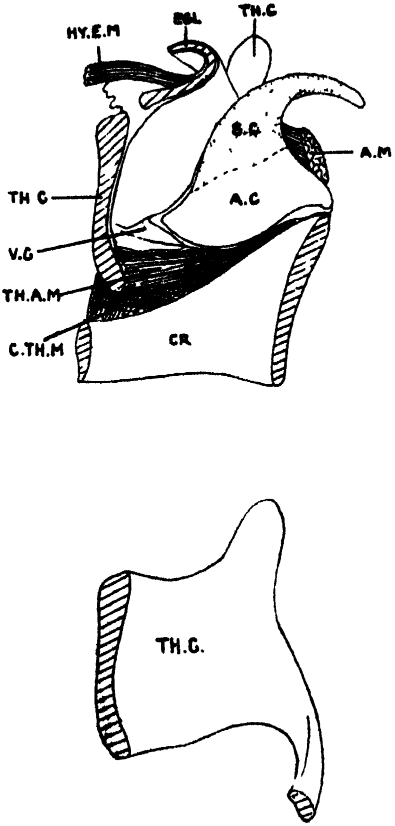
Longitudinal section of the pharynx and larynx of *Okapia johnstoni*

a.c., arytænoid cartilage, *a.p.ph.*, arcus palato pharyngeus (posterior pillar of fauces); *cr.*, cricoid cartilage, *œs*, œsophagus, *p*, soft palate, *t.f*, tonsillar fossa, *th.c.*, thyroid cartilage; *v.c.*, vocal cord.

Other lettering as in text-fig 14

has the simple form common to Ruminants. The eminence supported by the arytenoid and Santorini's cartilages is peculiarly large and prominent (text-fig. 14, *s.c.*). The general cavity (text-fig. 15) is quite simple, without recesses or pouches of any kind, and, as in the Giraffe, the vocal cords (text-fig. 15, *v.c.*) are

Text-figure 16.



Longitudinal section of the larynx of *Okapia johnstoni*, showing the cartilages.

Lettering as in text-figs. 14 & 15.

extremely rudimentary, represented only by minute folds connecting the ventral extremities of the enormous arytenoids to the mid-line of the thyroid cartilage. The cartilages (text-fig. 16) closely resemble those of the Giraffe. The muscles (text-fig. 14) are similar to those of other Ruminants, and call for no special comment.

The Tonsils (text-figs. 1, 4, 6).

The tonsillar fossa of the Okapi lies in the usual position (text-fig. 15, *t.f.*), between the anterior and posterior pillars of the fauces somewhat in advance of the hinder free margin of the palate. It is a simple oval pit, with its fundus subdivided into two or more subsidiary recesses. The fossa and the area surrounding it are covered externally by a nodulated mass of tonsillar tissue, which is encapsulated by a thin longitudinal sheet of muscle derived from the muscles of the palate.

The tonsils are thus of quite a usual Ruminant type, and very similar to those of the Giraffe. It is interesting, however, to note that in many Ruminants the single fossa is replaced by a row of separate incisions, which no doubt represent the subsidiary recesses in the fundus of the common fossa of the Okapi.

The Palate.

In 1915 the Royal College of Surgeons purchased the roughly prepared skeleton of a young male Okapi collected by Dr. Christy, in which the soft tissues covering the hard palate had not been removed. They are shown in the accompanying photograph (text-fig. 17).

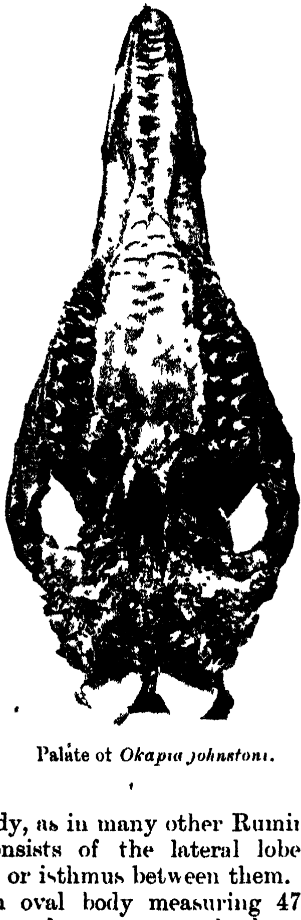
In front of the molar region the palate is extremely narrow, and throughout this region is traversed by a series of about 15 major palatal ridges. The anterior three or four are weak and do not extend across the entire breadth of the palate; they are succeeded by some twelve or so more complete ridges bowed forward in the centre and with their free papillate edges directed backwards. In the middle line these ridges are interrupted, the right half of each being situated in the majority of cases slightly posterior to the left. Behind the level of the anterior molar teeth, the palatal ridges become less and less pronounced and more nearly transverse in direction and gradually fade away, leaving the greater part of the intermolar area of the palate quite smooth.

Between the major palatal ridges are series of papillæ arranged transversely, forming minor ridges.

As in the Giraffe, there is no papilla incisiva, but at the extreme anterior end of the palate, in front of the palatal ridges, are two little longitudinal slits—the openings of the naso-palatine canals.

The soft palate terminates posteriorly in a simple curved border, without any indication of a uvula. Its lateral parts are prolonged, as the posterior pillars of the fauces, and become confluent upon the dorsal wall of the pharynx, forming, as in the majority of quadrupeds, a complete circular lip (arcus palato-pharyngeus) (text-fig. 15, *a.p.ph.*) through which the nasal passage communicates with the pharynx.

Text-figure 17.



Palate of *Okapia johnstoni*.

The Thyroid Body.

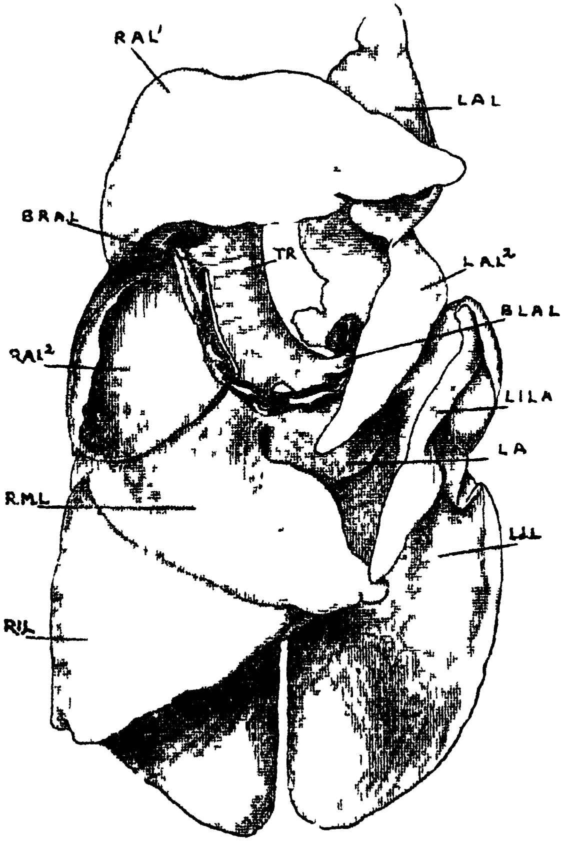
The thyroid body, as in many other Ruminants (Sheep, Antelopes, Giraffe), consists of the lateral lobes only, without a connecting portion or isthmus between them.

Each lobe is an oval body measuring 47 mm. in length × 16 mm. in breadth, and occupies much the same position as in Domestic Ruminants in the angle between the œsophagus the hinder part of the larynx and the trachea.

The Lungs (text-fig. 18).

The chief subdivision of the lungs follows the plan common to Ruminants, there being two lobes to the left lung and three and an azygos lobe to the right. The upper lobe of the right lung is partially divided into two minor lobes, the upper of which (text-fig. 18, *r.a.l.*[1]) is the larger of the two, and is bent in the characteristic Ruminant way transversely across the front of the heart The lower (text-fig 18, *r.a.l.*^{2}) is leaf-like and resembles the same lobule in the Sheep or Goat, but is relatively larger The middle and lower lobes and the azygos lobe resemble very closely those of the Goat.

Text-figure 18



The lungs of *Okapia johnstoni*, ventral aspect

b l a l bronchus of left apical lobe, *b r a l* bronchus of right apical lobe *l a*, azygos lobe, *l a l*^{1}, left apical lobe, longitudinal process *l a l*, left apical lobe, transverse or cardiac process *l i l* left inferior lobe *l i l a*, cardiac appendage of left inferior lobe *r a l*^{1}, right apical lobe, transverse process, *r a l*,^{2} right apical lobe, cardiac process, *r i l*, right inferior lobe, *r m l*, right median or cardiac lobe *tr*, trachea

The upper lobe of the left lung is very similar to that of the Goat or Sheep, except for the greater length of its anterior (text-fig. 18, *l.a.l.*¹) (longitudinal) lobule. The lower lobe (text-fig. 18, *l.i.l.*) is remarkably prolonged at its upper and outer angle, forming a long finger-like cardiac process (text-fig. 18, *l.i.l.a.*) that lies alongside the lower (transverse) lobule of the upper lobe (text-fig. 18, *l.a.l.*²), bound to it by a fold of pleural membrane. In the natural position these two elongated lobules embrace the left side of the heart.

The trachea, chief bronchial tubes, and pulmonary vessels call for no particular notice, as they resemble closely those of the Sheep.

The Heart.

The heart has a long narrow form, and measures 140 mm. in total length from base to apex, and 95 mm. in breadth at the upper part of the ventricles. The length of the ventricular portion is 120 mm.

It is of the same type as that of other Ruminants. In dissecting it, the musculi papillares of both atrio-ventricular valves gave one the impression of being more than ordinarily developed, particularly as regards the muscular swelling that forms the foundation of those of the anterior cusp of the mitral valve. The wall of the left ventricle seemed also to be thick for a heart of the size.

The moderator band in the right ventricle is noticeably small. The great arteries spring from the arch of the aorta by a single large innominate trunk, as in other narrow-chested Ungulates. Between the aorta and pulmonary artery is a large vestige of the ductus arteriosus.

There is at the root of the aorta in Ruminants a very characteristic splinter of bone (*os cordis*) supporting the attachment of one of the cusps of the aortic valve. In the Okapi this bone is represented by a plate of cartilage, but whether its unossified condition is a permanent character or is due to youth it is difficult to say definitely, but it should be noted that in the calf ossification * sets in almost immediately after birth, and that in *Antilocapra* † the os cordis is permanently cartilaginous.

The Thymus Body.

The thymus is a relatively small triangular mass of tissue attached by a fold of membrane to the antero-ventral surface of the pericardium. It measures 64 mm. in length × 55 mm. in breadth at its posterior end.

The Stomach ‡ (text-figs. 19, 20, 21, 22, 23).

In its general form (text-fig. 19) the stomach of the Okapi resembles that of the Giraffe and many Antelopes more nearly than that of the various other Ruminants figured by Cordier*. All four chambers (rumen, reticulum, psalterium, abomasum) are fully developed.

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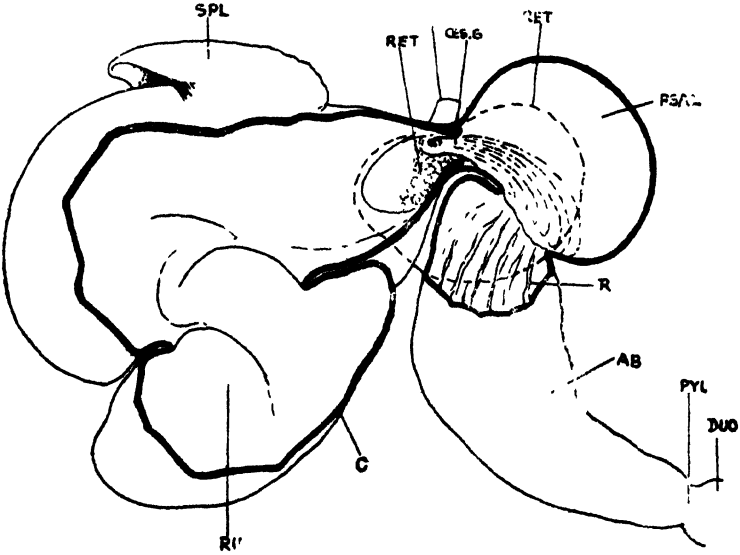
* Vaerst, "Herzknochen bei Wiederkäuern," Deutsch. Zeitschr. f. Thiermedicin, Bd. 30, 1888, p. 63.

† Murie, Proc. Zool. Soc. 1870, p. 348.

‡ Garrod, Proc. Zool. Soc. 1877, p. 5.

The paunch (rumen) is subdivided by folds into secondary chambers in a manner similar to that of Domestic Ruminants, and is lined throughout by coarse papillæ (text-fig. 20), mostly of large size and flattened lanceolate form, like those in the rumen of the Giraffe. Upon the free edges of the dividing partitions the papillæ are reduced in height and resemble flat scale-like plates rather than papillæ.

Text-figure 19.



Outline of the stomach of *Okapia*, with the cavities opened.

ab., abomasum; *duo.*, duodenal dilatation; *œs.*, œsophagus; *œs.g.*, œsophageal gutter; *psal.*, psalterium; *pyl.*, pylorus; *r.*, longitudinal rugæ in abomasum; *ret.*, reticulum seen through opening from the rumen; *ret.'*, outline of the reticulum; *spl.*, spleen.

The reticulum is a roomy, oval chamber, and is remarkable, like that of the Giraffe and *Antilocapra* †, for the extreme shallowness of its cells (text-fig. 21). In this particular it is approached by the reticulum of many Deer, and offers a striking contrast to that of Domestic Ruminants and the majority of Antelopes.

The psalterium is large, of about the same size as the reticulum, and contains some 14 chief laminæ. The spaces between the chief laminæ are occupied by others of less height, constituting according to their size and position secondary, tertiary, and quaternary series.

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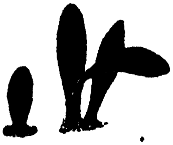
* Cordier, Ann. des Sci. Nat. t. xv. 1893, pl. 6.

† Murie, Proc. Zool. Soc. 1870, p. 349.

The position and height of the different series are shown to scale in the accompanying diagram (text-fig. 23). It is to be noticed that of the quaternary series those only interposed between the secondary and tertiary series are represented by definite laminæ. Those between the tertiary and primary, when they are represented at all (and they apparently are not in every case), are indicated only by a row of minute papillæ (text-fig. 23, *p.*), as the whole quaternary series is in the Giraffe and certain other Ruminants*.

Text-figure 20.

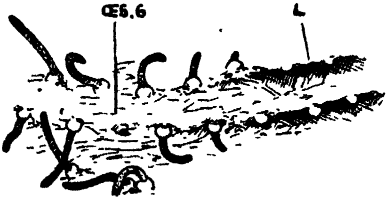


Text-figure 21.

Text-fig. 20.—Papillæ of rumen, × 2.

Text-fig. 21.—Cell of reticulum, nat. size.

Text-figure 22.



Specialised papillæ of œsophageal gutter, nat. size.

l., lamina of psalterium; *œs.g.*, roof of œsophageal gutter.

Towards the œsophagus the laminæ gradually fade away, and are succeeded by rows of enlarged papillæ similar in character but not in size to those that cover the surface of all the laminæ. Some of these papillæ are enormously developed (text-fig. 22) and form, when the œsophageal gutter is closed, a coarse filter to prevent unsuitable food from passing into the psalterium.

Papillæ similar to these, though fewer in number and smaller in size, are present in the stomach of the adult Ox, at the entry of the œsophageal gutter into the psalterium.

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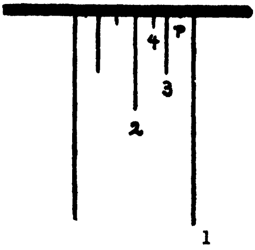
* Garrod, Proc. Zool. Soc. 1877, p. 5.

In the Okapi each of these special papillæ of the œsophageal gutter consists, like those on the free margin of the leaves of the psalterium, of a fleshy base and a horny apex. The separation of the base from the apex is quite abrupt and clear, giving to the papilla the appearance of a long horny rod set upon the summit of a rounded fleshy boss.

The digestive stomach (abomasum) calls for no particular comment. Its walls become gradually more and more muscular towards the pylorus, beyond which the commencement of the duodenum is marked, as in other Ruminants, by a sudden dilatation. The lining membrane, towards the cardiac end, is longitudinally folded.

Text-figure 23.



Diagram, to scale, of laminæ of psalterium.

1, 2, 3, 4, laminæ of primary, secondary, tertiary, and quaternary series.
p., lamina of quaternary series represented by row of papillæ.

In the small portion of œsophagus preserved there was found a mass of partly masticated food. This was composed of small fragments of the leaves of trees. Though the fragments were too small to offer much likelihood of detailed identification, Mr. L. A. Boodle, of the Jodrell Laboratory, Kew Gardens, most kindly undertook to examine them. He reports that they "consist, chiefly at any rate, of fragments of Dicotyledonous plants, grasses being apparently absent. A few specimens show considerable resemblance to leaflets of certain Leguminosæ, but these and the fragments of other plants present have not been identified. No definite opinion has been arrived at as to the stature of the plants concerned."

This report, in the apparent absence of grass, agrees with the field observations made by Dr. Christy. He says that the animal "feeds chiefly on the small leaves and twigs of trees." "It does not eat grass, but does browse on the coarse herbage on the outskirts of the forest"*.

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* Quoted from 'The Field,' July 10, 1915, by Sir H. H. Johnston, 'Nature,' Aug. 16, 1915, p. 714; see also to the same effect, Wilmet, C.R. Acad. Sci. Paris, 1913, vol. 156, p. 2007.

The Spleen.

The spleen (text-fig. 19, *spl.*) is massive and wedge-shaped, and is situated, as in other Ruminants, upon the left anterior surface of the paunch, adherent by its thick end to the diaphragm and with its narrow edge projecting freely to the left into the abdominal cavity.

The Colic Coil.

The colic coil is flat, not conical as in the Giraffe, and is almost circular, measuring 190 mm. in diameter. The gut of which it is constituted is relatively narrow (20 mm. in diameter), and is arranged in 3½ concentric and 3½ excentric coils. This number appears to be high. In Antelopes of which I have seen records * it apparently varies from 1 to 3, in the Ox it is 1½, in *Antilocapra* 3 †, and in the Giraffe may be as many as 4 ‡.

In judging of the bearing of the above anatomical facts, it must be borne in mind that they are records of one individual only, but assuming that they fairly represent the condition normal for the species, the following points seem to be most worthy of note :—

A. In comparison with the Giraffe:

1. The form and superficial anatomy of the tongue.
2. The condition of the geniohyoid and genioglossus muscles.
3. The occipito-styloideus muscle and the form of the styloid bone.
4. The structure and form of the larynx.
5. The arrangement of the lingual arteries.
6. The general form of the stomach, and particularly the character of the reticulum.

B. As more or less characteristic of the Okapi:

1. The papillæ of the sublingual fringe.
2. The cartilaginous os cordis.
3. The elongation of the upper angle of the left lower lobe of the lungs.
4. The specialised papillæ in the œsophageal groove of the stomach.

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* Beddard, Proc. Zool. Soc. 1909, i. p. 181; Mitchell, Trans. Zool. Soc. xvii. 1905, p. 473.

† Beddard, *l. c.*

‡ Owen, Trans. Zool. Soc. vol. ii. 1841, p. 227.

EXHIBITIONS AND NOTICES.

March 20th, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The **Secretary** read the following report on the Additions made to the Society's Menagerie during the month of February 1917:—

The registered additions to the Society's Menagerie during the month of February were 101 in number. Of these 36 were acquired by presentation, 44 were received on deposit, 19 were purchased, and 2 were born in the Gardens.

The number of departures during the same period, by death and removals, was 115.

Amongst the additions special attention may be directed to:—

1 Allamand's Grison (*Grison allamandi*) from Le Quiacea, Bolivia, presented by A. S. Hume on February 10th.

1 European Bison (*Bison bonasus*) ♂, born in the Menagerie on February 22nd.

2 Golden Eagles (*Aquila chrysaetus*) from Ross-shire, presented by Lady Bignold of Rosque on February 16th.

Mr. R. I. **Pocock**, F.R.S., F.Z.S., Curator of Mammals, exhibited a young Lion Cub recently deposited in the Gardens, and also a Galago from German East Africa presented by Commander R. J. N. Watson.

April 3rd, 1917.

Prof. E. W. MacBride, M.A., D.Sc., F.R.S., Vice-President,
in the Chair.

Mr. C. J. **Gahan** exhibited a living example of the "Death-Watch" Beetle (*Anobium tesselatum*), and demonstrated its response to sharp taps, such as could be made with the point of a pencil on the table.

Mr. C. Davies Sherborn, F.Z.S., exhibited an autograph of Captain Bligh of 'The Bounty.'

Mr. C. Tate Regan, M.A., F.Z.S., exhibited a Piraya (*Serrasalmo piraya*) from the Amazon, and gave a short account of the habits of this ferocious fish.

Big-Game shooting in Cooch Behar, Assam, and the Bhutan Duars, India.

Mr. Alfred Ezra, F.Z.S., gave a lantern exhibition illustrating Big-Game Shooting in Cooch Behar, Assam, and the Bhutan Duars, India, and made the following remarks:—

On account of the heavy grass- and reed-jungle, sometimes well over 20 feet high, so common in these districts, it is impossible to do any shooting on foot. All big-game shooting is done here with the aid of elephants, which are thoroughly trained for the purpose. During the shooting-season the country is generally burnt in patches, and here one follows the method adopted in covert-shooting in England. Two or more guns are sent in with the line of elephants, while some guns are posted forward as "stops," and the patches are beaten up to them. The elephants used for the "stops" are generally very steady and well-trained animals and are most valuable. The shooting arrangements at Cooch Behar are reduced to a science, and the men in charge of the line are so well trained that a tiger can invariably be beaten out to any particular "stop," should the Maharaja wish a special guest to have the first shot. My favourite way of shooting in this country is to go alone on a pad-elephant with an intelligent mahout (driver) who is a good tracker. In this way you go through the thickest parts of the jungle without disturbing the game, and you see the animals in their natural haunts, sleeping, grazing, or wallowing in the muddy streams. Being accustomed to always seeing wild elephants, the animals do not take the slightest notice of your mount, and you are able to get within a few yards of them. At such close quarters the sportsman can pick and choose his head, only shooting something that is worth having as a trophy. The game found in this country consists of tiger, leopard, bear, rhino, buffalo, bison (gaur), sambur, swamp-deer, wild pig, and hog deer.

April 17th, 1917.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President,
in the Chair.

The SECRETARY read the following report on the Additions made to the Society's Menagerie during the month of March 1917:—

The number of registered additions to the Society's Menagerie during the month of March was 149. Of these 21 were acquired by presentation, 125 (chiefly small Finches) were received on deposit, 2 by purchase, and 1 was born in the Gardens.

The number of departures during the same period, by death and removals, was 101.

Amongst the additions special attention may be directed to:—

1 White-handed Gibbon (*Hylobates lar*), from Pahang, deposited on March 29th.

1 Bushy-tailed Galago (*Galago crassicaudata*), from Mafia I., East Africa, presented by Commander R. J. N. Watson, R.N., on March 5th.

1 White-toothed Shrew, from Albert, France, new to the Collection, deposited on March 23rd.

Mr. C. DAVIES SHERBORN, F.Z.S., exhibited the piece of hairy skin of a Gorilla, which specimen was torn off the freshly killed beast, and posted to Richard Owen, by P. B. Du Chaillu, from the interior of the Gaboon. The envelope is postmarked "Etablissements du Gabon, 1 Sept 1864," and was the precursor of Du Chaillu's long letter of August, 1864, from the Fernand Vaz river on the coast, announcing that six skins were being shipped to London among other specimens. These were registered at the British Museum 1 Dec. 1864.

Mr. D. SETH-SMITH, F.Z.S., Curator of Birds, exhibited a female Japanese Pheasant (*Phasianus versicolor*) which had assumed the very nearly complete plumage of the male. The ovaries were found on dissection to be very atrophied.

A male specimen of the Carolina Duck (*Æx sponsa*) was also shown in which the colour of the soft parts were similar to those of the female. When living, this bird was thought to be a female in male plumage, but on dissection proved to be a male with atrophied testes.

Mr. Seth-Smith also showed some specimens of the trachea of various species of Ducks.

Mr. E. HERON-ALLEN, F.L.S., P.R.M.S., F.Z.S., described the Mussel-fishery and Foraminifera of Esnandes (La Rochelle), and the early work of Alcide d'Orbigny.

A series of slides was exhibited illustrative of the early studies of Alcide d'Orbigny at Esnandes (near La Rochelle), and the Mussel-fisheries established there since the year 1035. The experiments of Prof. W. A. Herdman on the West Coast of England were referred to, and those of Prof. A. Meek at Holy Island on the East Coast. A further series was shown illustrating some of the notable d'Orbignyan species found in the neighbourhood, not recorded from there by d'Orbigny in 1826, but recorded from other localities at that date, and from distant seas between 1839 and 1846. A third series of slides illustrated well-known species from the locality which had been recorded and described by earlier authors, but were not apparently identified by d'Orbigny from the neighbourhood of La Rochelle.

May 1st, 1917.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President, in the Chair.

The SECRETARY, Dr. P. CHALMERS MITCHELL, F.R.S., announced with the deepest regret that Mr. Henry Peavot, the Society's Librarian and Clerk of Publications, had been killed in action. Mr. Peavot had entered the service of the Society in 1896, and, after passing through various departments, was appointed Assistant Librarian and Clerk of Publications in 1908, and was promoted to the post of Librarian and Clerk of Publications in 1912. In every way he had gained the esteem and regard of the Scientific Fellows of the Society, and was one of the most valuable and competent members of the Society's staff.

The SECRETARY exhibited a coloured sketch of an abnormal Cape Lourie (*Turacus corythaix* Wagl.), kindly sent to him by Mr. E. C. Chubb, F.Z.S., the Curator of the Durban Museum, Natal. The specimen, which was the property of the Durban Museum, was normally coloured on the head and neck, but the rest of the plumage was pale grey or dirty white, with the exception of a portion of the wings, which retained the normal red colour. The example could not be exactly described as an albino, inasmuch as the red colour was known to be due to a pigment, the "Turacin" originally described by Professor Church, and the green colour of the head and neck, unlike that in most species of birds with green feathers, was due also to a green pigment.

A Gynandromorphic Specimen of the Earwig (Forficula auricularia).

Prof. J. P. Hill, F.R.S., F.Z.S., remarked as follows:

The specimen (a photograph of which was exhibited) attracted attention by reason of the asymmetry of its forceps. The right limb of the latter measured 3·25 mm. in length, and is unmistakeably of the male type, being stout and distinctly curved. The left limb measured 2·75 mm., and is just as unmistakeably of the female type, being slender and only slightly curved.

Dissection of the specimen revealed the presence of a well-developed testes, containing fully formed sperms, on the *right* side. The left gonad was not observed and was probably either absent or very rudimentary. It is certain that a well-developed ovary was not present on this side.

Dr. A. Smith Woodward, F.R.S., Vice-President, exhibited enlarged models, made by Mr. Frank O. Barlow, of the first lower molar tooth of a large Chimpanzee, Melanesian Man, and Piltdown Man (*Eoanthropus dawsoni*). He maintained that the latter tooth was of the megadont human type.

Mr. D. M. S. Watson, F.Z.S., exhibited and explained by diagrams, models of the teeth of fossil horses.

Professor H. Maxwell Lefroy, M.A., F.Z.S., described the Silkworms and Silk industry of India, illustrating his account with lantern-slides and specimens of the Silk Moths, Cocoons, and Silk.

May 15th, 1917.

Dr. S. F. Harmer, M.A., F.R.S., Vice-President,
in the Chair.

The Secretary read the following Report on the Additions made to the Society's Menagerie during the month of April 1917:—

The registered additions to the Society's Menagerie during the month of April were 130 in number. Of these 46 were acquired by presentation, 33 were received on deposit, 48 by purchase, 1 in exchange, and 2 were born in the Gardens.

The number of departures during the same period, by death and removals, was 93.

Amongst the additions special attention may be directed to:—

1 Chimpanzee (*Anthropopithecus troglodytes*) ♀, from West Africa, presented by Lieut.-Comm. J. W. Rainier, R.N., on April 16th.

1 Demidoff's Galago (*Hemigalago demidoffi*) ♂, from Obuassi, Ashanti, presented by Dr. G. H. F. Spurrell on April 5th.

2 Pandas (*Ælurus fulgens*) ♂ ♀, from Nepal, purchased on April 12th.

Dr. P. Chalmers Mitchell, M.A., D.Sc., F.R.S., Secretary to the Society, showed the behaviour of a large series of Birds and Mammals in the presence of living Serpents, and demonstrated that, except in the case of the higher Monkeys and a few kinds of Birds, there was no trace of instinctive dread of Serpents.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, gave a lantern exhibition of Birds now or recently living in the Society's Gardens.

June 5th, 1917.

Dr. S. F. Harmer, M.A., F.R.S., Vice-President,
in the Chair.

Mr. R. I. Pocock, F.R.S., Curator of Mammals, exhibited on behalf of Messrs. Rowland Ward Ltd. the skins of two Zebras, shot by Mr. David Mackenzie at Gil-Gil in British East Africa, which showed remarkable evanescence of pattern affecting the body, neck, and head and to a less extent the legs. The obliteration of pattern was carried to a much greater extent than in the skin described by Prof. Ridgeway as representing a new variety named *Equus quagga goldfinchi*.

The two specimens were secured from a herd of normally coloured Zebras of the East African race *Equus quagga granti*.

Mr. R. E. **Holding** exhibited and made remarks on a Cirriped (*Coronula diadema*) which occurs in considerable numbers on the Humpbacked Whale (*Megaptera nodosa* Bonn.).

Mr. Holding also exhibited two curiously malformed eggs in which the inner membrane only remained, the shell and yolk being absent.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, gave an account of the Poultry Exhibition which the Society is now holding for the second season with a view to the encouragement of poultry-keeping for egg-production. The method of keeping hens on the intensive system was explained, as well as the lines to be followed in the breeding and selection of heavy-laying strains. Mr. Seth-Smith called attention to the value of certain strains of ducks, especially those known as "white runners," for egg-production.

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PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY

OF LONDON.

1917, pp. 217–338,

WITH 5 PLATES and 33 TEXT FIGURES.

PRINTED FOR THE SOCIETY,
SOLD AT ITS HOUSE IN REGENT'S PARK.
LONDON:
MESSRS. LONGMANS, GREEN, AND CO.,
PATERNOSTER ROW.

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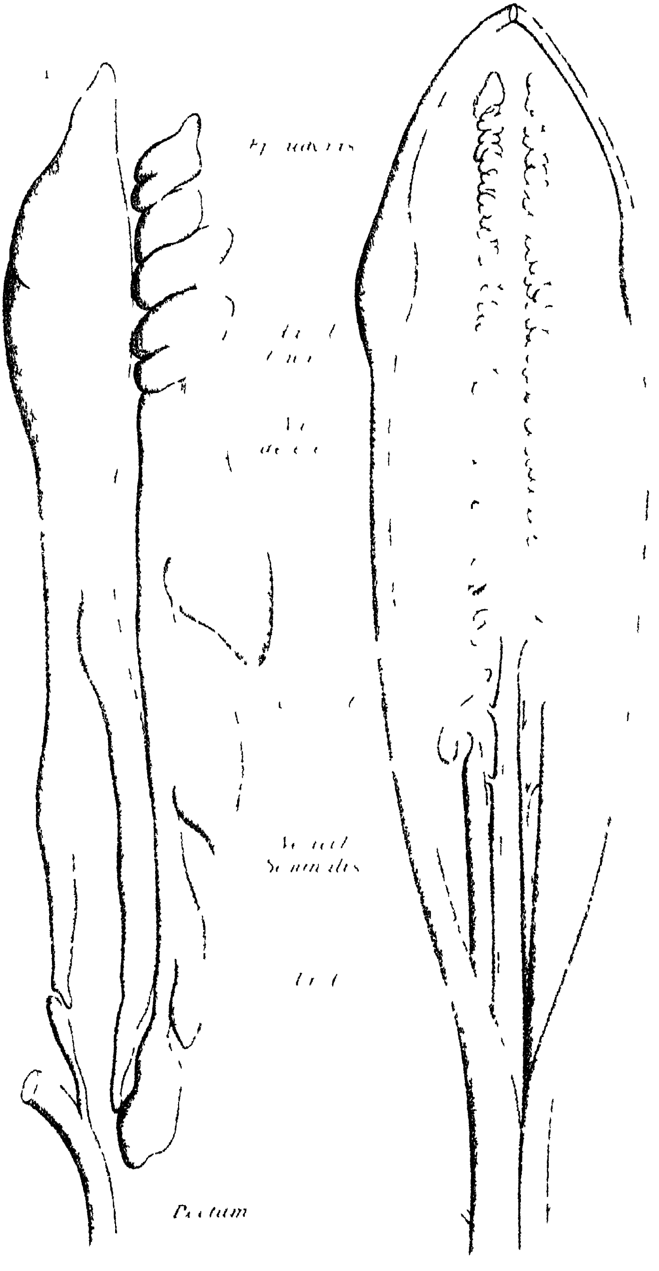

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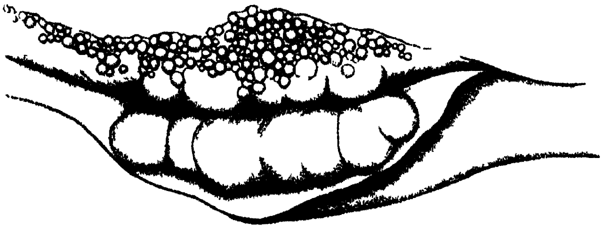

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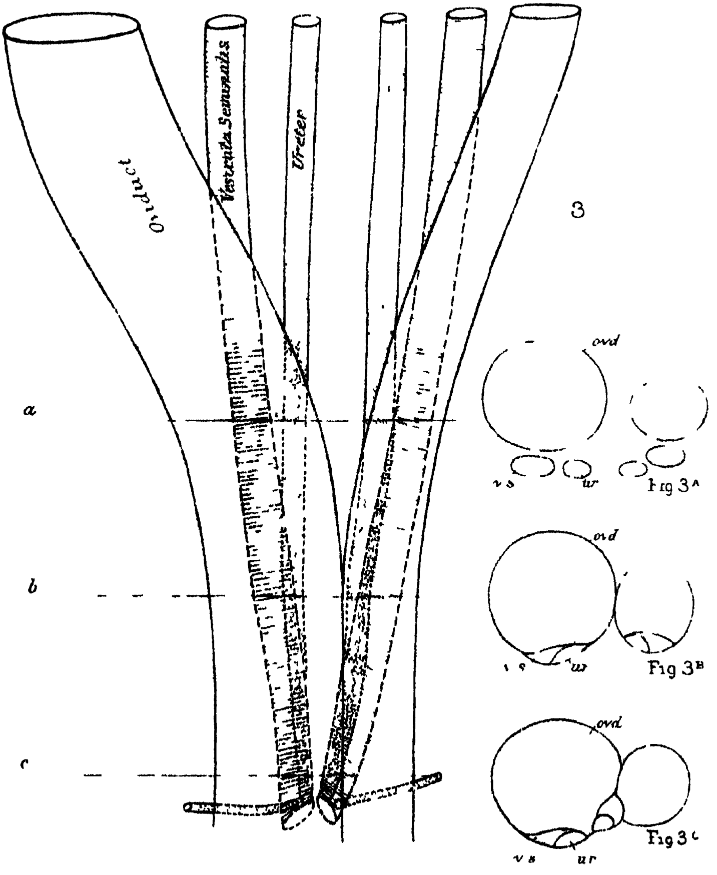

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SCYLLIUM CANICULA HERMAPHRODITE CONDITION.

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12. Note on a Hermaphrodite Dogfish.

By Ruth C. Bamber, M.Sc.[*]

[Received August 8, 1917 Read October 23, 1917.]

(Plates I. & II.[†])

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A case of hermaphroditism in *Scyllium canicula* L. has recently come under my notice whilst demonstrating in the Zoology laboratories at the University of Liverpool, and, as the condition is rare in Selachians, it may be of interest to record the details.

In 1914, Vayssière and Quintaret[‡] described a hermaphrodite specimen of *Scyllium stellare* L. from the Gulf of Marseilles, but it was quite unlike the one I have seen. Their specimen had the left pelvic fin like that of a normal female, and the right like that of a male, with the clasper well developed. Internally an ovary and both oviducts were present. Also there was one testis, the right, united with the posterior end of the ovary, and the male ducts were normally developed on the right side only.

---

[*] Communicated by C. Tate Regan, F.R.S., F.Z.S.

[†] For explanation of the Plates see p. 219.

[‡] A. Vayssière et G. Quintaret, "Sur un cas d'hermaphrodisme d'un *Scyllium stellare* L.," C. R. Ac. Sci. Paris, 158. pp. 2013–2014.

The urinary system was not connected in any way with the genital system, the right and left ureters joining together to form a short common canal which opened separately into the cloaca, on a papilla behind the female genital opening.

There does not appear to be any other record of hermaphroditism in *Scyllium*; but Semper*, in 1875, recorded a rudimentary testis in a female *Hexanchus*.

The specimen which is described below came from Port Erin, Isle of Man. It was unfortunately so badly damaged that the description is necessarily incomplete.

Externally the animal was a typical male; the claspers were well developed, and the pelvic fins were united together along almost the whole length of their inner edges.

Internally, both male and female organs were present. Both testes were developed, and except for the lobate character of the left testis, looked normal when seen from the ventral surface (Pl. I. fig. 1). On the dorsal surface, however, the right testis showed a small mass of ova developed at the anterior end, on the inner side. Dissection showed that the ovarian part formed about half the thickness of the right gonad, and was confined to the anterior end (Pl. II. fig. 4). The oviducts were normal, and each had an oviducal gland. The right duct and gland were considerably larger than the left. The ducts opened together into the cœlom anteriorly as in a normal female. Posteriorly they were united together by their adjacent walls for about 2 cm., but their cavities remained distinct (Pl. I. fig. 2). The external opening was not seen.

The male ducts were well developed. The vasa efferentia were not seen because of the damage to the mesentery, but on each side there was a well-defined epididymis, and a long, narrow, convoluted vas deferens, increasing in diameter posteriorly to form the straight vesicula seminalis. Sperm sacs were not present (fig. 2). Posteriorly each vesicula seminalis united with the dorsal wall of the oviduct of its own side, and for a short distance after uniting, the right one ran parallel with the oviduct and then opened into it. The left one, however, ran obliquely in the wall of the left oviduct towards the median line of the body until it reached the wall separating the two oviducts, and then opened into the right one, side by side with the opening of the right vesicula seminalis (Pl. II. fig. 3). No papilla was formed, but a little fold of the wall of the oviduct surrounded the two male genital openings, so that they lay in a slight depression.

The interrelationship of the genital ducts, as also the complete development of the oviducts coupled with the absence of sperm-sacs, might suggest the possibility that the sperm-sacs are normally developed from the posterior ends of the degenerate oviducts. The specimen described by Vayssière and Quintaret, however, conclusively disproves any such homology, for it had both oviducts well developed and also the sperm-sac of the right side.

---

* Semper, "Das Urogenitalsystem der Plagiostomen und seine Bedeutung für das der utrigen Wirbelthiere," Arb. Inst. Wuzburg, Bd. 2, 1875, pp. 195-500 (see p. 278 & Taf. xiv.).

The ureter of each side was attached to the inner side of the vesicula seminalis, slightly in front of the point where the latter became united with the wall of the oviduct; behind this point it was united also with the wall of the oviduct. The ureter opened into the vesicula seminalis of its own side immediately before the latter opened into the oviduct. The small duct from the posterior end of the kidney opened separately into the vesicula seminalis on a level with the opening of the ureter.

It will be seen that, except for the absence of sperm-sacs, this animal had the complete genital systems of both male and female, and thus showed the completion in the adult of the primitive embryonic condition in which both male and female genital ducts are potentially present.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Gonads, from ventral surface about natural size.
2. Urinogenital ducts semi-diagrammatic about natural size.

PLATE II.

Fig 3 Diagram of posterior part of urinogenital ducts. Ventral view.
Figs 3*a*, 3*b*, & 3*c*. Diagrams of transverse sections of urinogenital ducts at *a*, *b*, & *c* respectively.
Fig 4. Anterior end of right gonad, dissected to show hermaphrodite character of that region Ventral view The gonad has been split along the inner edge, and the ventral half turned back to show the ovarian region about 1½ natural size.

13. On the Use of the Names *Plesiosauria* and *Sauropterygia*.
By G. A. Boulenger, F.R.S., F.Z.S.

[Received October 6, 1917: Read November 6, 1917.]

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I wish to point out the misapplication, or rather inverted application, of the names *Plesiosauria* and *Sauropterygia* by some of the most recent writers on the classification of fossil Reptiles.

The order *Plesiosauria* was so named, and properly defined, by de Blainville in 1835 *; the genus *Plesiosaurus* was then its only representative.

When, in 1839, Owen † accepted the name *Enaliosauria* (Conybeare, 1821) for the marine Reptiles known as Plesiosaurs and Ichthyosaurs, which were associated in one order, he designated the former as *Plesiosauri* and the latter as *Ichthyosauri*. After the relationship of the Nothosaurs to the Plesiosaurs had been recognised by Hermann von Meyer, they were placed together as *Plesiosauri* by Quenstedt in 1852 ‡.

Plesiosauria (1835-1852) is the earliest name for the order in question, it is open to no objection, and it should therefore be used, as it has been by Huxley, Gegenbaur, Cope, Baur, Hay, and myself.

In 1859, Owen §, dropping the artificial group Enaliosauria, proposed to call *Sauropterygia* and *Ichthyopterygia* the two orders on which he had already bestowed names which there was no need to change. The Sauropterygia were defined as long-necked marine Reptiles with fin-like limbs with not more than five digits. Owen insisted on the character of the limbs as distinctive of the order and, although accepting the proposition that the Nothosaurs should be included, remarked, rather inconsistently:—"I continue, as in my former Report of 1841, to regard the fin-like modification of the limbs as a better ordinal character than the number of vertebræ in any particular region of the spine . . . . . . The *Plesiosaurus*, with its very numerous cervical vertebræ, sometimes thirty in number, may be regarded as the type of the *Sauropterygia* or pentadactyle sea lizards."

It is therefore perfectly clear, and beyond discussion, that the earlier name *Plesiosauria*, also the better from its non-committal meaning, should stand for the order in its wide sense; and that the later name *Sauropterygia* should only be applied, in accordance with Owen's definition and express designation of the type, as well as with its etymology, to the suborder including the *Plesiosauridæ*, *Pliosauridæ*, and *Elasmosauridæ*, in which the limbs are transformed into hyperphalangeal fin-like paddles.

---

* Ann. Mus. Paris (3) iv. p. 241.—Reference to this important contribution to the classification of Reptiles has unfortunately been omitted from O. P. Hay's most useful bibliography, Bull. U.S. Geol. Surv. no. 179, 1902.

† Rep. Brit. Assoc. 1839, p. 45; also 1841, p. 60.

‡ Handbuch der Petrefaktenkunde, p. 130.

§ Rep. Brit. Assoc. 1859, p. 159.

14. Some Additions to the known Dragonfly Fauna of Borneo, with an Account of new Species of the Genus *Cœliccia*. By F. F. LAIDLAW, M.A., F.Z.S.

[Received September 4, 1917: Read November 6, 1917.]

(Text-figures 1–10.)

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ZYGOPTERA.

Family AGRIONIDÆ (=CŒNAGRIONINÆ Kirby).

Legion PLATYCNEMIS.

CŒLICCIA FLAVOSTRIATA, sp. n. (Text-figs. 1, 2.)

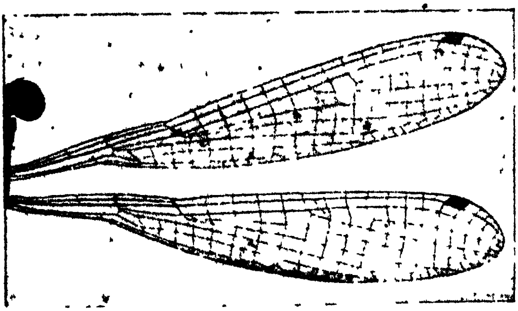
2 ♂♂. Mt. Merinjak, 21–28. v. 14. (The second specimen is the type.)

1 ♂. Mt. Matang, 4. xii. 13.

Length of abdomen 35 mm., of hind wing 21·5 mm.

M_1 rises at level of subnodus, Rs a little after*. Three cells between quadrilateral and subnodus. Costal margin of quadrilateral three-fifths the length of anal margin in fore wing; three fourths in hind wing.

Text-figure 1.



Wings of *Cœliccia flavostriata* Laidlaw. Type ♂.

Pterostigma dark brown, sides approximately parallel, covering rather more than one cell. 12–13 postnodals on fore wing. (Text-fig. 1.)

---

* The veins are indicated by the Comstock-Needham notation.

Head: Lower lip yellowish white, otherwise the head is black *except* the anteclypeus and extreme base of upper lip, which are white, and a pair of transverse marks, cuneiform in shape, on either side of the hinder ocelli, these marks being yellowish white.

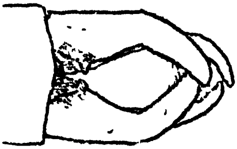
Prothorax: Anterior and posterior lobes black, middle lobe yellow, with a very fine median black line.

Thorax black above, yellow at the sides and underneath, a pair of orange-yellow antehumeral stripes, and at the top of either shoulder, just outside the stripes, a fine yellow spot. On the side of the thorax a black line on the second lateral suture, incomplete below.

Abdomen: Segment 1 yellow, with median line of black. Segments 2-5 brown, paler below, each with a black terminal ring. The remaining segments progressively darker, the last two bronze-black.

The youngest of the three males has a whitish, diamond-shaped spot on the dorsum of segment 10.

Text-figure 2.



Calicnia flavostriata, ♂.

Anal appendages, seen from above.

Anal appendages black, upper pair longer than segment 10, lower pair one-third longer than upper pair. Upper pair moderately stout, incurved, flattened dorso-ventrally towards the free extremity; each carries an internal tooth at the end of its basal third. In the youngest specimen the flattened part of the appendage is yellow. The lower pair are slender, cylindrical and incurved. (Text-fig. 2.)

Legs: Femora yellow, with black stripes; tibiæ brown, tarsi and spines black.

Type ♂ in the British Museum. Paratypes, one in my own collection, and one to be returned to the Sarawak Museum.

CŒLICCIA CAMPIONI, sp. n. (Text-figs. 3, 4.)

1 ♂. Lio Matu, 31. x. 14.

Length of abdomen 37 mm., of hind wing 21 mm.

Postnodals on fore wing 13.

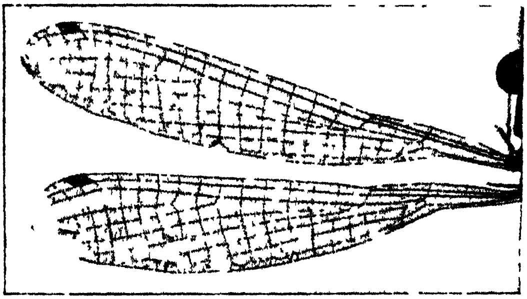
Closely allied to the preceding species (*C. flavostriata*). It differs as follows:—

Colour: No cuneiform markings on vertex. Markings on prothorax and thorax bluish white, possibly blue in life. The black lateral line on thorax relatively longer.

Venation: The pterostigma is more oblique, its inner and outer margins more definitely parallel than is the case in *C. flavostriata*. (Text-fig. 3.)

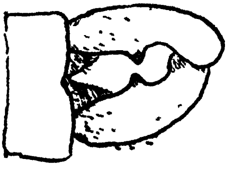
Prothorax: The posterior lobe carries a very fine projecting point at either lateral angle, not present in *C. flavostriata*.

Text-figure 3.



Wings of *Cœliccia campioni* Laidlaw. Type.

Text figure 4.



Cœliccia campioni, ♂

Anal appendages, seen from above.

Anal appendages (see text fig. 4): Upper pair a trifle longer than lower, stout and a little incurved; hooked sharply downwards at the extremity; each carries at its middle an inwardly directed spur. Lower pair stouter and relatively much shorter than in *C. flavostriata*; hooked in towards each other distally.

Type ♂ in the British Museum.

These two small species, characterized by their open reticulation and antehumeral stripe, would appear to form an independent section of the genus.

CŒLICCIA MACROSTIGMA, sp. n. (Text-figs. 5, 6.)

1 ♂. Baram, Borneo, 20. x. 10 (1 ♀, Baram, 19. x. 10).

Length of abdomen, ♂ 35 mm., of hind wing 21 mm.

„ „ „ (♀ 33 mm., „ „ 22 mm.)

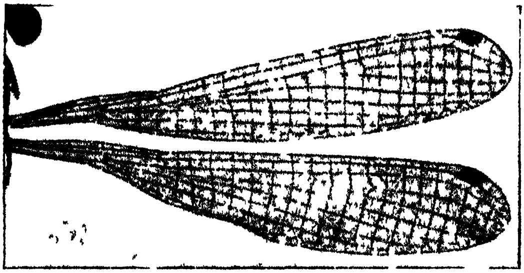
Postnodals $\frac{15 \mid 15}{14 \mid 15}$. (♀ $\frac{14 \mid 14}{13 \mid 13}$.)

M_1 rises at subnodus, Rs a little distal. Three cells between quadrilateral and subnodus. Costal margin of quadrilateral three-fourths the length of anal margin in the fore wing, four-fifths in the hind wing.

Pterostigma brown, with fine pale margin, rather large, distinctly broader than the cells of the postnodal costal area. In the front wing it lies over a single long and narrow cell, in the hind wing it covers one cell and a half. (Text-fig. 5.)

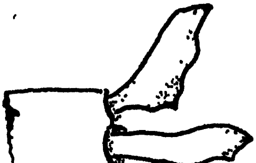
Head Upper lip and anteclypeus black, genæ and lateral parts of postclypeus yellow, the latter black in the centre. Frons and vertex black, base of antennæ and a minute spot on either side of the posterior ocelli yellow. Occiput black, with yellow postocular mark.

Text-figure 5.



Wings of *Cœliccia macrostigma* Laidlaw, ♂ Type.

Text figure 6.



Cœliccia macrostigma, ♂.

Anal appendages.

Prothorax: Anterior and posterior lobes black; middle lobe, ventral and lateral surfaces whitish (probably blue in life).

Thorax: Dorsum black, with broad (blue?) antehumeral bands. These are indented at the middle by a black mark projecting from the inner side. Laterally the thorax is bluish white, ventrally yellowish white; a fine black line runs along the second lateral suture.

Legs yellowish white, the joints, spines, and a line on the femora black.

Abdomen: Segment 1 yellowish white with dorsal brown spot; segments 2–7 brown, becoming darker posteriorly, with narrow black apical rings, 2 has a small pair of basal lateral blue (?) spots; segment 8 is black above, yellowish white below, 9 and 10 yellowish white. During life the light colouring on these segments is probably blue; 9 and 10 have fine black basal rings.

Anal appendages yellowish brown (?blue) tipped with black. Upper pair a trifle longer than lower pair, each with a large triangular projection inwards and downwards, scarcely visible in profile. Lower pair cylindrical, slightly incurved, and with a distinct elbow at the middle. (Text-fig. 6.)

The presumed female of this interesting species has most unfortunately been completely destroyed whilst in my possession. I have, however, in my possession an account of the specimen which I append here.

Colouring in general very similar to that of the male. It differs as follows:—

1. Antehumeral band of thorax completely divided by the black projecting mark into a broader lower part, which is rounded below and pointed above, and a narrower upper part, which is linear.
2. *Abdomen*: Segment 1 entirely yellowish brown above; 8 pale above (probably blue during life); 9 black, with a pair of pale marks above on either side of the middle line; 10 black.

The structure of the *prothorax* is very remarkable. A curious crescentic projection stands out on either side of the middle lobe attached to the prothorax by its convex border. When looked at obliquely from above, each of these projections shows like the moon at the end of the first quarter, but when viewed directly from above each shows as a single outstanding spur.

In addition the black posterior margin of the prothorax carries a fine black spur mid-dorsally. This is nearly ·5 mm. in length, and projects forwards and upwards at an angle of about 45° to the long axis of the body. On either side of this projection lies a small lappel, also black, directed backwards.

I do not know of any structure in the Legion Platycnemis that can be compared to the crescentic structure on the prothorax, except in the females noted below.

This female was taken in the same locality as the male, and the two specimens were captured on two consecutive days. They agree in size and wing-characters, and closely in colouring, though in this respect they are by no means identical. The evidence that they belong to the same species is not conclusive, though enough to justify the assumption that they may do so.

Type ♂ in the British Museum.

Cœliccia nigrohamata, sp. n. (Text-figs. 7, 8.)

6 ♂ ♂. Mt. Merinjak, Borneo, 21–28. v. 14.

Length of abdomen 38 mm., of hind wing 24 mm.

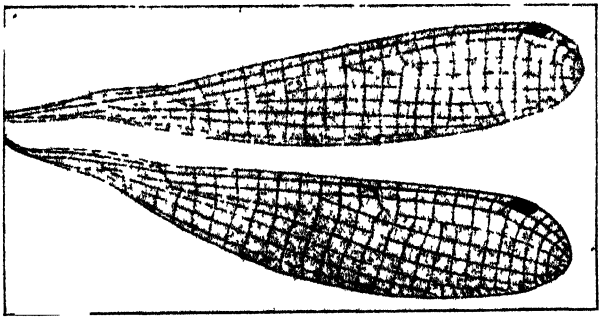
M_1 rises from subnodus, Rs a little distal. Three cells between quadrilateral and subnodus. Costal margin of quadrilateral about two-thirds the length of anal margin in fore wing; four-fifths in hind wing. Postnodals 17 18.

Pterostigma black, covering 1½ 2 cells. (Text-fig. 7.)

Head: Upper surfaces black, except for a pair of yellow marks on the genæ, and a pair of minute yellow spots on the vertex on either side of the hinder ocelli.

Prothorax black, with lateral and ventral parts yellow.

Text-figure 7.



Wings of *Cœliccia nigrohamata* Laidlaw, ♂ Type.

Thorax: Dorsum bronze-black; on either side of the mid-dorsal carina are two silver-blue spots, the lower large and elliptical, the upper small and linear. The black colour extends to the level of the first lateral suture, beyond this as far as the second lateral suture the side of the thorax is of a dull purple-blue colour. Below this the thorax is yellowish white, delimited by a black line along the second lateral suture.

Legs yellowish brown; the articulations and spines black, as are a line on the posterior surface of the femora and on the anterior surface of the tibiæ.

Abdomen. Segments 1–7 black, 1 with yellow on the sides; segment 8 is black dorsally and blue below; segments 9 and 10 are blue.

Anal appendages black; the upper pair shorter than the lower pair, obliquely truncate, with two internal ventral teeth on each. Lower pair slender, incurved, pincer-like (see text-fig. 8).

Type ♂ in the British Museum.

Cœliccia sp. (Text-fig. 9.)

3 ♀ ♀. Kuching, Sarawak.

These specimens belong to a species probably closely allied both to *C. macrostigma* and to *C. nigrohamata*. They may even belong to the latter species, but as there is no definite evidence on the subject I note them here separately.

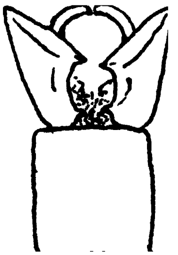
Length of abdomen 22 mm., of hind wing 34 mm.

M_3 rises at or immediately before subnodus, Rs distal; costal margin of quadrilateral two-thirds length of anal margin in the fore wing, four-fifths in the hind wing. Three cells between quadrilateral and subnodus.

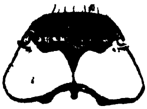
Head black, upper lip with paired yellow spot at its base; frons with yellow line from eye to eye. Yellow marks between ocelli, antennæ, and eyes, small linear postocular mark of the same colour.

Prothorax: Anterior and posterior lobes black, middle lobe yellow, with median longitudinal black stripe. On either side of the lateral lobe is developed a small projecting spur, similar to that found in the presumed female of *C. macrostigma*, but not so largely developed (see text-fig. 9). Posterior margin with fine median spine about ·25 mm. long.

Text-figure 8.



Text-figure 9.



Text-fig. 8.—*Cœliccia nigrohamata*, ♂. Anal appendage.
Text-fig. 9.—*Cœliccia* sp., ♀. Prothorax, seen from above.

Thorax black above, with large concentric antehumeral bands, concave inwards, blue in colour. Sides and under surfaces yellow; a fine black band on the second lateral suture, incomplete below.

Legs yellow; spines and articulations, and a band on the posterior surface of femora, black.

Abdomen brownish black above; segment 1 yellow; segments 9 and 10 black. Ventral side brownish yellow. Pale, small antero-lateral lunules on segments 3 and 4.

Cœliccia sp.

1 ♂. Platang Rd.

There remains to be noted this specimen, which is unfortunately incomplete, being without the head. It is evidently very closely allied to *C. nigrohamata*, but differs in the following respects. Segment 8 of the abdomen has its terminal quarter ringed with blue, the blue mid-dorsally has its margin indented with black. The upper anal appendages are brownish black, more abruptly truncate than is the case in *C. nigrohamata*, and distinctly though very little longer than the lower pair. The lower pair are relatively stouter than in *C. nigrohamata*, and are brownish yellow (probably blue in life).

The three species, *C. macrostigma*, *nigrohamata*, and that to which this male belongs will probably constitute another distinct section of the genus *Cœliccia*, characterized by small size, rather dense reticulation of wings, as opposed to the open venation of *C. flavostriata*; by the shape of the upper anal appendages of the male; and probably by the prothoracic structure of the female.

To this group I believe it will be found that the species called *Trichocnemis octogesima albicauda* by Förster (which I suggest should be named *C. albicauda* (Forst.)), also belongs.

CŒLICCIA MEMBRANIPES (Ramb.), race NEMORICOLA Laidlaw.

C. nemoricola Laidlaw, Journ. R. Asiat. Soc. Str. Br. no. 63, p. 95 (1912); id. Proc. Zool. Soc. London, 1915, p. 37.

I have re-examined the examples of this form from Mt. Kina Balu, and have come to the conclusion that they may fairly be taken as representing a local race of the widely-spread *C. membranipes* (Ramb.). The character most readily employed for separating males of *nemoricola* from the typical *membranipes* is afforded by the colour of the upper anal appendages, which are blue in *membranipes*, black in *nemoricola*.

The Kina Balu specimens show marked variability in size and in venation.

Measurements of 5 males taken at random from amongst the 15 male specimens that I have received from Mr. Moulton are as follows:—

Length of abdomen 47 mm., 43 mm., 41 mm., 45 mm., 45 mm.

" hind wing 30 mm., 28 mm., 26 mm., 30 mm., 30 mm.

The number of postnodal costal nerves ranges from 16 to 21.

The point of origin of M_3 and Rs varies greatly, as shown in the following table taken from the same males.

$$a = \left\{\begin{array}{l} M_3 \text{ rises at subnodus.} \\ \text{Rs distal.} \end{array}\right.$$

$$b = \left\{\begin{array}{l} M_3 \text{ rises proximal to subnodus.} \\ \text{Rs distal.} \end{array}\right.$$

$$1.\ \begin{array}{c|c} a & a \\ a & b \end{array}. \quad 2.\ \begin{array}{c|c} b & b \\ b & b \end{array}. \quad 3.\ \begin{array}{c|c} a & a \\ a & a \end{array}. \quad 4.\ \begin{array}{c|c} b & a \\ a & a \end{array}. \quad 5.\ \begin{array}{c|c} a & a \\ b & b \end{array}.$$

Cœliccia octogesima (Selys).

C. octogesima Kirby, Cat. Odonata, p. 128 (1890).

1 ♀. Matang Rd., 3. i. 10.

This specimen, unfortunately much damaged, agrees well with the description of the type female in the Synopsis.

It differs from other females of the genus I have seen in the greater length of the spine developed on the posterior margin of the prothorax, which projects forward at an angle of about 45° to the main axis of the body and is approximately 1 mm. in length.

I have not been able to identify any of the species I have seen with *C. borneensis* Selys, and as the Bornean species are evidently numerous, and often very similar in appearance, it will be difficult to redetermine Selys' species.

Legion Agrion.

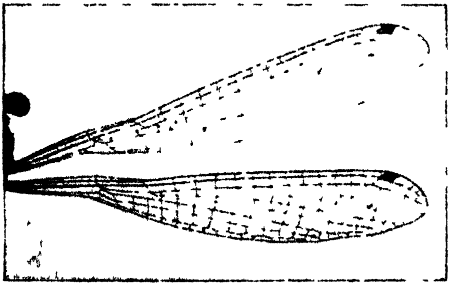
Stenagrion dubium (Laidlaw). (Text-fig. 10.)

Pseudagrion ? dubium Laidlaw, Journ. R. Asiat. Soc. Str. Br no. 63, 1912, p. 97, pl. fig. 5.

Stenagrion dubium Laidlaw, Proc. Zool. Soc. London, 1915, p. 39.

I take the opportunity of figuring here the venation of the type male of this interesting species (text-fig. 10). It shows a development which parallels with remarkable exactitude that of *Cœliccia*. I am indebted for the photograph of the wings of this species, and of all the new species of *Cœliccia* described in this note, to Messrs. H. and F. E. Campion, to whom I desire to tender my best thanks.

Text-figure 10.



Wings of *Stenagrion dubium* Laidlaw. Type ♂.
Mt. Batu Lawi, Borneo, 27. v. 11.

Teinobasis superba (Selys).

Teinobasis superba Kirby, Cat. Odonata, p. 157 (1890); Ris, Nova Guinea, xiii. Zool. pp. 100, 101, 122 (1915).

1 ♂. Lio Matu.

The specimen belongs, I think, to the typical race of this species.

ANISOPTERA.

ÆSCHNIDÆ.

GOMPHINÆ.

HETEROGOMPHUS SUMATRANUS Krüger.

Heterogomphus sumatranus Krüger, Stett. Entom. Zeit. 1898, p. 294.

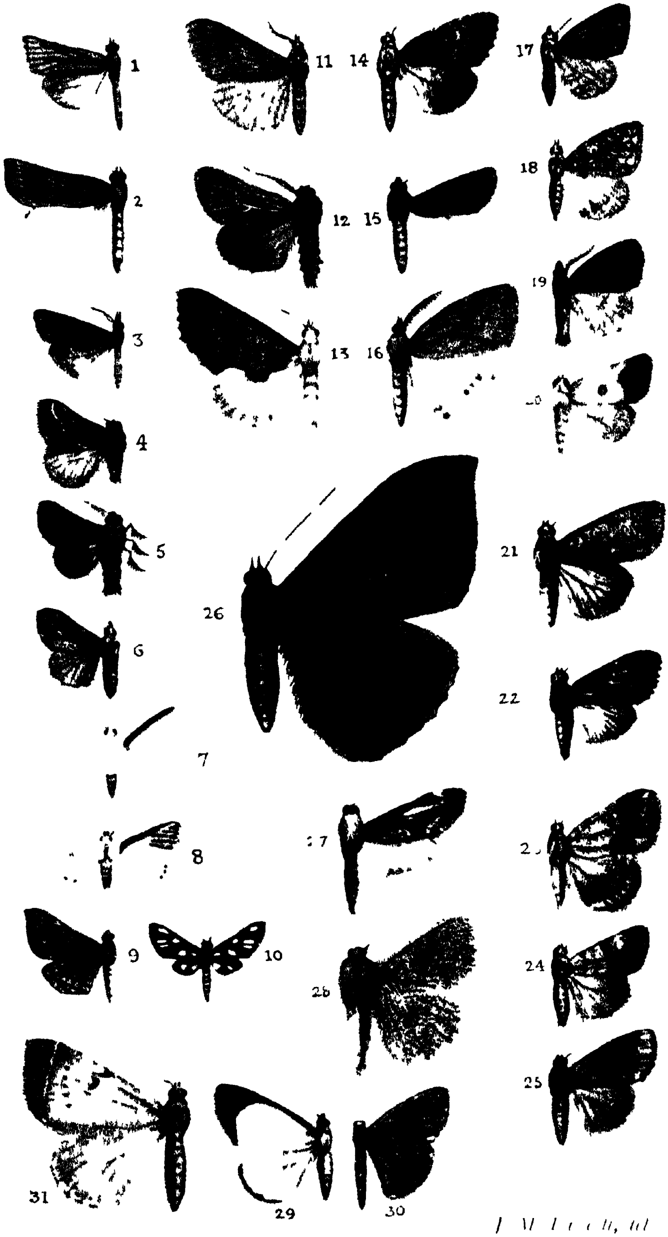
5 ♂♂. Retuh, 15–16. v. 14.

Mr. J. C. Moulton tells me that this species has blue eyes. It is otherwise remarkable for the rich chestnut-brown colouring of the thorax and abdomen. The latter has the apices of segments 2–9 ringed with black.

The species is quite distinct from *H. icterops* Martin.

[NOTE.—Owing to the great difficulty of setting the wings of these very fragile insects, some distortion of the wing-base has occurred in the specimens photographed. This is especially the case with the types of *C. macrostigma* and *C. nigrohamata*, consequently the figures of the wings of these species (text-figs. 5 and 7) do not exhibit clearly the course of the "anal bridge" vein, which is, however, that normally found in the genus.]

P.Z.S. 1917 Fawcett Pl. I



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HETEROCERA FROM BRITISH EAST AFRICA
AND SOME OTHER LOCALITIES

MENPES PRESS WATFORD

15. Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911-13. By Lt.-Col. J. M. Fawcett *.

[Received October 10, 1917 : Read November 20, 1917.]

(Plate I.†)

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The object of the third memoir on this subject is to describe a few more of the remaining forms of this collection in my possession, and to figure some of the forms described in my second memoir, published in 1916, of which I was unable to give figures from want of space on the plate.

The forms dealt with in the present memoir were taken at Kedai (altitude 2500 feet) and Masongaleni (altitude 3000 feet) in B. E. Africa, with the exception of a few specimens taken by Lady Colvile at Meru, B. E. Africa. At the end I have described two new forms from India and Australia, which have been some time in my possession awaiting an opportunity of publication.

It will be noticed that among the forms from B. E. Africa there are a good many which are typical of the desert, of which *Euphiusa hermione*, *Ctenusa psamatha*, *Galactomoia berenice*, described in my former memoir, and *Cynisca thisbe*, in this one, are notable examples, which seem to occur along with darker, richer-coloured forms such as we should expect to meet with in a country of considerable rainfall. Not being acquainted with the district myself, and having no notes on the subject by Mr. Feather, I regret I cannot offer an explanation of this curious phenomenon.

I notice that my first memoir on this subject, published in

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* Communicated by the SECRETARY.

† For explanation of the Plate see p. 250.

P. Z. S. 1915, has evoked a certain amount of criticism, and that from a quarter from which I did not expect it, as one of the writers was good enough to help me in the thankless task of working out my specimens amongst the vast material in the British Museum Collection, and to agree with me at the time in the conclusions I arrived at.

These criticisms refer to my descriptions of what I consider as new forms of Sphingidæ, and I would remark that until the preliminary stages and life-history of the specimens are known (and we are still in ignorance of them), I do not see how anyone, even the highest authority on the subject, can say as an absolute fact that such a specific name is a synonym of one already described. Such an assertion is merely a matter of opinion. In any case, it is desirable that undescribed forms from an extensive country like British East Africa, which has not been worked out to any great extent, should receive names in these days, when the Lepidoptera of each separate island in the Eastern Archipelago are being given distinct names as geographical forms—even when obviously belonging to well-known previously described species. The reader has only to refer to Seitz, 'Macrolepidoptera of the World,' to verify what I say. In making the above remarks I do not, for a moment, deprecate criticism; on the contrary, it is most interesting to me to read it, and, as I am a correspondent to the press on sporting subjects during the winter months, I get my fair share of it.

The figures in the accompanying plate are drawn by myself to represent the exact size. In this memoir B. M. stands for British Museum, and C. L. P. for 'Catalogue of the Lepidoptera Phalænæ,' by Sir George Hampson.

My best thanks are due to Lord Rothschild, Mr. Louis Prout, and Mr. J. H. Durrant, for their kindness and ever ready help in the British Museum.

HETEROCERA.

Family SYNTOMIDÆ.

249. SYNTOMIS POLYXO, sp. n. (Pl. I. fig. 10.)

Description.—♂. Black, shot with coppery suffusion in certain lights. Antennæ black with white tips; frons orange-yellow; collar black; patagia with orange-yellow stripes; metathorax with an orange patch; abdomen black, with six yellow bands. Fore wing with the following white diaphanous spots:—one below base of cell; an oblique diamond-shaped spot below middle of cell and vein 2; a spot in end of cell; an elongate spot above vein 6, and two spots between veins 3 and 5. Hind wing with a large basal spot between median nervure and inner margin, and a smaller one beyond end of cell, above vein 3.

The plan of markings is similar to that of *S. humeralis* Butler, from North Australia (C. L. P. i. pl. ii. fig. 15, p. 63); but this form is much smaller, and the spots are white, and not yellow as in that species.

This is the smallest form of *Syntomis* that I am acquainted with, and the figure is slightly larger than natural size.

Habitat Kedai, 31st December, 1911, 2 ♀; 15th March, 1912, 1 ♂. Expanse, ♂ 13, ♀ 15 mm.

Family ARCTIADÆ.

Subfamily ARCTIANÆ.

250. ESTIGMENE TENUISTRIGATA Hampson, Ann. S. Afr. Mus. ii. p. 54 (1900); C. L. P. pl. xlviii. fig. 16.

Habitat. Masongaleni, 18th April, 1911, 1 ♀.

250 *a*. ESTIGMENE LEMNISCATA Distant, A. M. N. H. (7) i. p. 116 (1898); C. L. P. pl. xlvii. fig. 20.

Habitat. Meru, B. E. Africa, taken by Lady Colvile, 1 ♂.

This specimen is much more heavily marked, as regards the black bands, than the figure above quoted, and, moreover, has a black band along the costa.

250 *b*. ESTIGMENE LINEA Walker, Cat. iii. p. 671 (1855), C. L. P. pl. xlvii. fig. 2.

Habitat. Meru, B. E. Africa, taken by Lady Colvile, 2 ♂.

These specimens agree fairly well with the figure in C. L. P., but one example is much lighter in tone than the other, whilst both have more heavy black markings.

251. TERACOTONA SUBTERMINATA Hampson, C. L. P. iii. p. 471, pl. l. fig. 16 (1901).

Habitat. Masongaleni, 18th April, 1911, 1 ♂.

Family HYPSIDÆ.

252. BITHRA AGANICE, sp. n. (Pl. I. fig. 11.)

Description.—♀. Head and thorax pale grey-brown; antennæ black, and pectinate for half the length, filamentous thence to tip. Two black spots on collar, two on each of the patagia, and one on metathorax. Abdomen pale orange, with a dorsal row of black spots on first three somites, and a lateral series on each somite. Fore wing pale grey-brown, with the following black points: two basal; two subbasal, one of which is near the base of costa, and one below base of cell; two antemedial one of which is below cell, and one above vein 1; one in cell before middle, and one in interspaces 3, 4, and 6, near base, and beyond cell. Hind wing dull yellow. Underside similar to upperside, unmarked.

This form is nearest to *Bithra ayanois* Felder, which has only one basal black spot and one in cell.

Habitat. Kedai, 7th January, 1912, 1 ♀. Expanse 36 mm.

Family NOCTUIDÆ.

Subfamily AGROTINÆ.

253. **CLADOCEROTIS ŒNEUS**, sp. n. (Pl. I. fig. 12.)

Description.—♂. Head, thorax, abdomen, and fore wing pale red-brown. Head and thorax densely covered with thick long hair; abdomen with lateral tufts of hair. Fore wing with the veins, orbicular and reniform pale ochreous; reniform defined outwardly by black lines. Interior of cell dark red-brown, with a black line below costa from base to middle. Claviform very elongated and black, from base to beyond middle. An irregular series of black wedge-shaped spots subterminally between veins 4, 5, and 6, double the size of those between the other veins. A fine black terminal line. Cilia ochreous on both wings. Hind wing with the basal area ochreous and the terminal area pale fuscous.

This form seems to be allied to *C. optabilis* Boisd., from Europe, but is larger than the figure in C. L. P. and much darker, the claviform is black, not ochreous defined by black, the marginal spots are irregular, and the hind wings ochreous and pale fuscous instead of white as in that species.

Habitat. Meru, taken by Lady Colvile, 2 ♂, 1 ♀. Expanse 36 mm.

The ♀ specimen is darker in colour, the markings are more ill-defined, and the antennæ are not so highly pectinated.

254. **POROSAGROTIS CAFFRA** Hampson, C. L. P. iv. p. 658, pl. lxxvii. fig. 29 (1903).

Habitat. Meru, taken by Lady Colvile, 1 ♀.

255. **ADISURA ATCINSONI** Moore, P. Z. S. 1881, p. 368, pl. xxxvii. fig. 6.

Habitat. Kedai, 6th March, 1912, 1 ♂.

This form is very variable, and the specimen under notice has darker hind wings than some specimens in the B. M. from British East Africa.

256. **CHLORIDEA OBSOLETA** Fabricius, Ent. Syst. 3, i. p. 546 (1793).

Habitat. Kedai, 16th March, 1912, 1 ♂.

Formerly known as *armigera* Hubner, Samml. Eur. Schmett. fig. 370 (1827).

Subfamily HADENINÆ.

257. **ODONTESTRA AVITTA**, sp. n. (Pl. I. fig. 15.)

Description.—♂. Head, thorax, and abdomen pinkish brown. Fore wing pinkish brown, chestnut in the medial area. Subbasal and antemedial lines represented by a single thick black line. Claviform short and thick, black. A black line on inner margin from base below vein 1 to antemedial line. No ochreous white fascia on medial part of inner margin. Orbicular and reniform large, extending over costa, pinkish defined outwardly by indistinct ochreous. Postmedial line excurved round reniform and thence straight to inner margin—a thick black line. An indistinct subapical spot below costa. Hind wing white with some ochreous irroration near the apex. Underside pale ochreous, with discocellular spots and diffused postmedial lines.

This form differs from *vittigera* Hampson, from Mashonaland and Natal, in being without the ochreous-white fascia on medial part of inner margin, that part of the wing being concolorous with the remainder; also in the following characters:—the orbicular and reniform are larger and spread out over the costa, and are pinkish in colour; the ante- and postmedial lines are thick black single lines, not double lines filled in with ochreous; the subterminal area beyond the postmedial line is plain pinkish brown, without a trace of any marks save a small subapical spot below the costa.

It also differs from *albivitta* Hampson (C. L. P. v. p. 206) in being without the whitish fascia above the claviform, which species is also recorded from British East Africa.

Habitat. Kedai, 8th December, 1911, 1 ♂. Expanse 30 mm.

Subfamily ACRONYCTINÆ.

258. PERIGEA CAPENSIS Guén. Noct. i. p. 213 (1852).

Habitat. Masongaleni, 22nd June, 1911, 1 ♂.

259. LAPHYGMA EXEMPTA Walker, Cat. x. p. 355 (1856).

Habitat. Kedai, 1911, 24th November, 1 ♂; 25th November, 2 ♂.

260. PARASTICHTIS OXYLUS, sp. n. (Pl. I. fig. 22.)

Description.—♂. Head, thorax, abdomen, and fore wing dark red-brown with black-brown markings. Fore wing: subbasal and antemedial lines only represented by strigæ on the costa. Orbicular and reniform defined by fine black lines with a dark shade on and below the costa between them; an irregular dentate postmedial line angled inwardly above veins 4 and 6, and outwardly at veins 4 and 3, with some black lines running from it to the outer margin. A black band starting from base under vein 1, angled up to vein 2, and running below it to postmedial line, and thence on to outer margin. Hind wing pale ochreous basally and fuscous towards the apex. Cilia of fore wing black and ochreous chequered, of hind wing whitish. Underside pale ochreous.

Habitat. Kedai, 19th November, 1911, 1 ♂. Expanse 34 mm.

261. **Parastichtis lysis**, sp. n. (Pl. I. fig. 25.)

Description.—♂. Head and thorax bright ferruginous, abdomen reddish ochreous. Fore wing bright ferruginous, the subterminal area beyond the postmedial line pale ochreous. Orbicular and reniform defined outwardly by fine black lines and with a dark shade below the costa between them. Subbasal and antemedial lines obsolete. A black line from the base of interspace 1 to middle, where it is recurved upwards and then inwards. Another black line from base below vein 1, with a small black spot on inner margin below it. Some black streaks with bright red edges between the veins on the subterminal area. Postmedial line highly dentate. Hind wing pale ochreous, darker towards the termen. Underside pale ochreous, with fuscous discocellular spots and diffused postmedial bands.

Habitat. Kedai, 1911, 10th November, 1 ♂; 18th November, 1 ♂. Expanse 34 mm.

Of the large number of species (39) of the genus *Parastichtis* given in C. L. P. vii., only one is recorded from Africa, *nigricostata* Hampson, which is a totally differently-coloured insect.

The first of the forms under notice may always be known by the prominent curved black band below vein 1, and the second by its bright ferruginous colour.

Subfamily Sarrothripinæ.

262. **Giaura arethusa**, sp. n. (Pl. I. fig. 14.)

Description.—♂. Head, thorax, and abdomen grey. Fore wing grey, minutely irrorated and striated with fuscous. Subbasal line represented by a V-shaped striga on the costa. Antemedial line represented by another costal striga which gradually becomes obsolescent in the cell, with a dark shade beyond it. Postmedial line outwardly oblique to vein 4, then bent inward, and becoming obsolete before reaching the inner margin. A highly dentate submarginal line with diffused fuscous shading beyond it, from apex to near tornal angle, where there is a black spot before it. A fine marginal black line. Cilia grey. Hind wing pale ochreous at the base, terminal area fuscous black. Cilia ochreous. Underside of fore wing ochreous, thickly irrorated with fuscous towards the margin; hind wing white with a black subterminal band.

Habitat. Kedai (date not recorded), 1 ♂. Expanse 34 mm.

Subfamily Erastrianæ.

263. **Ozarba subterminalis** Hampson, P. Z. S. 1910, p. 407; C. L. P. x. pl. clxii. fig. 1.

Habitat. Kedai, 27th November, 1912, 1 ♂.

264. **Ozarba varia** Walker, Cat. xxxiii. p. 772 (1865).

Habitat. Kedai, 5th January, 1912, 1 ♂.

This specimen has orange hind wings in contradistinction to some specimens in the B. M. Collection; but the species is exceedingly variable.

265. **Ozarba sinua** Hampson. C. L. P. x. p. 414, pl. clx. fig. 31 (1911).

Habitat. Kedai, 18th November, 1911, 1 ♂.

This specimen represents a very light form of the species.

266. **Ozarba abscissa** Walker, Cat. xv. p. 1764 (1858).

Habitat. Kedai, 9th December, 1911, 1 ♂.

Subfamily Acontianæ.

*148. **Leocyma candace** Fawcett, P. Z. S. 1916, p. 712. (Pl. I. fig. 20.)

As promised in my former paper, quoted above, I am now able to give a figure of this species, which the reader is requested to compare with the woodcut figure of *camilla* Druce, in C. L. P. xi. p. 663, and that of *discophora* Hampson, pl. cxci. fig. 19.

Subfamily Catocalinæ.

*152. **Ctenusa rectilinea** Fawcett, P. Z. S. 1916, p. 713. (Pl. I. fig. 31.)

A figure is here given of the typical form: no. 2 form *psamatha* was figured in my memoir published in 1916 (P. Z. S. 1916, Fawcett, Pl. I. fig. 21).

*162. **Cortyta minyas** Fawcett, P. Z. S. 1916, p. 715. (Pl. I. fig. 17.)

Cortyta griseacea Fawcett, P. Z. S. 1916, p. 718. (Pl. I. fig. 18.)

Figures are now given of the above species. As both *minyas* and *griseacea* have been taken in December 1911 at Kedai, they can hardly be seasonal forms of the same species, and I am now of the opinion that they are distinct forms.

267. **Plecopterodes moderata** Wallengren, Wien. Ent. Mon. iv. p. 174 (1860).

Habitat. Masongaleni, 22nd April, 1911, 1 ♂.

Subfamily Noctuinæ.

*181. **Plecoptera polymnia** Fawcett, P. Z. S. 1916, p. 722. (Pl. I. fig. 23.)

A figure is here given of this form. The reader has only to compare it with the figure of *polymorpha* Hampson, P. Z. S. 1916, pl. ii. fig. 3, to see how it differs from Hampson's species, which is clearly a desert form.

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* These numbers refer to my paper in P. Z. S. 1916, p. 707 *et seq.*

268. **BREVIPECTEN ICARUS**, sp. n. (Pl. I. fig. 24.)

Description.—♂. Head and thorax grey; abdomen ochreous. Fore wing with the basal half grey, the costa tinged with ferruginous. Subbasal line represented by two black spots below the costa and on the median nervure. Antemedial line very faint and indistinct. A square black patch before end of cell, with two small black spots above it on costa, separated by a patch of ferruginous suffusion, and with a patch of ferruginous suffusion below it on interspaces 1, 2, and 3, before the postmedial line. Reniform large, represented by a grey patch, beyond which the postmedial line is angled outwardly at vein 6, and is then evenly curved inwards to inner margin. A black patch on costa before apex with ferruginous suffusion before it. Subterminal area pale brown, with a marginal row of indistinct wedge-shaped spots between the veins. Hind wing ochreous, darker towards the margin. Cilia ochreous. Underside: medial areas of both wings grey, subterminal area pale fuscous; costa ochreous, with some black strigæ on that of hind wing, and a discocellular spot.

Habitat. Kedai, 28th November, 1911, 1 ♂. Expanse 32 mm.

Genus CYNISCA, nov.

Type, *C. thisbe*, sp. n.

Allied to *Calpe*. Proboscis fully developed. Palpi long, porrect, the 2nd and 3rd joints fringed with long hair above and below. Antennæ ciliate; metathorax with slight tufts of hair, which also appear on dorsum of abdomen on first three somites. Costa of fore wing straight, not arched. Apex rectangular, not acute. Outer margin crenulate, evenly rounded. Inner margin with a very pronounced lobe at middle, and a smaller lobe at tornal angle. Venation as in *Calpe*.

269. **CYNISCA THISBE**, sp. n. (Pl. I. fig. 13.)

Description.— ♀. Head, thorax, and abdomen ochreous white. Antennæ red. Fore wing pale brown, shading into pale purple on the centre lobe and the area above it, and with a purple shade on outer margin. Antemedial line red-brown from costal nervure to inner edge of lobe, with a short line beyond it. A medial line from end of cell to outer edge of lobe, where it is bent inwards and becomes double. A very indistinct dentate postmedial line from before apex to outer lobe. Cilia pale brown. Hind wing white, with a pale ochreous shade on the veins on outer margin. Cilia white. Underside ochreous white, marked only by the postmedial band of the upperside showing through.

Habitat. Kedai, 9th March, 1913, 1 ♀. Expanse 42 mm.

This is clearly a well-marked form of the desert.

270. **PTERONYCTA CERVICORNIS**, sp. n. (Pl. I. fig. 21.)

Description.—♂. Head, thorax, abdomen, and fore wing pale pinkish grey. Fore wing: subbasal and antemedial lines only indicated by a couple of black spots. Orbicular stigma, a fine black point with a fine black line round it. Reniform indistinct. Postmedial line represented by a double row of black points bent in to inner margin. A broad red-brown band from base along median nervure to end of cell, where it is bent up into a tooth, then curving down to outer margin at vein 4. The area below this band reddish towards base. Some small ferruginous stripes between veins 3, 4, and 5 submarginally. Hind wing grey, the terminal area fuscous. Cilia ochreous. Underside pale ochreous, with a fine striga at end of cell of fore wing.

Habitat. Kedai, 13th January, 1913, 1 ♂. Expanse 40 mm.

I have named this form *cervicornis*, from a fancied resemblance of the broad red band to a stag's antler.

The only species in the B. M. Collection which seems to be near this form is the recently described *Pteronycta fasciata* Hampson, from Zomba in Nyassaland, which is a much larger insect.

Subfamily HYPENINÆ.

*189. HYPENA JUSSALIS Walker.

Habitat. Kedai, 1911, 29th December, 1 ♂; 30th December, 1 ♂.

HYPENA STRIGATA Fabricius.

Habitat. Kedai, 25th November, 1911, 1 ♂; 3rd January, 1912, 1 ♂.

In my former paper I mentioned that the specimens of *Hypena* in the Feather collection represent two forms, a grey and a brown form. I now find that the grey form is *jussalis* Walker, and the brown form *strigata* Fabricius.

Family LYMANTRIADÆ.

271. CASAMA VILIS Walker.

Habitat. Masongaleni, 25th June, 1911, 1 ♀.

Specimens of this species in the B. M. Collection are nearly all from Ceylon and Arabia, but there are a few from the Red Sea littoral which agree with this specimen. Clearly a desert form.

272. RHODESANA MINTHA, sp. n. (Pl. I. fig. 19.)

Description.—♂. Head, thorax, abdomen, and fore wing chestnut red-brown. Antennæ bipectinate. Abdomen with dorsal tufts. Fore wing thickly irrorated and striated with black. A subbasal black line from costa to vein 1. Antemedial line irregularly waved and bent inwards on vein 3, and thence more or less straight to inner margin. A line of wedge-shaped red-brown submarginal spots between the veins before termen. Cilia red-brown, whitish at the extremities of the veins. Hind wing ochreous, irrorated with red-brown atoms, with a somewhat indistinct medial line across the disc. Underside ochreous, with indistinct brown medial band.

Habitat. Masongaleni, 27th March, 1911, 1 ♂ ; Kedai, 27th November, 1912, 2 ♂. Expanse 32 mm.

This form is nearest to *R. crenulata* Bethune Baker, but is much smaller and redder than that species. It also differs in the postmedial line being angled in on vein 3, and there being a medial line across the disc of the hind wing.

273. HETERONYGMIA AURELIA, sp. n. (Pl. I. fig. 16.)

Description.—♂. Head and thorax golden yellow, abdomen ochreous. Antennæ bipectinate. Palpi long, thickly covered with long hair. Fore wing golden yellow; no antemedial lines. Three oblique lines, red-brown, and leading in the shape of a **V** from the costa to a dark red-brown shade at end of cell. A narrow waved oblique postmedial line from costa just before apex to middle of inner margin. A subterminal line of black points between the veins. Cilia reddish yellow. Hind wing ochreous; a fuscous spot at tornal angle with a fuscous striga above it, and three fuscous discal spots between veins 3, 4, 5, and 6.

Underside: fore wing bright ochreous, with a fuscous band on discocellulars, and a thicker fuscous postmedial band than that on the upperside; hind wing bright ochreous, with medial band and discal spots as on the upperside.

Habitat Meru, B. E. Africa, taken by Lady Colvile. Expanse 38 mm.

There are no specimens of this genus in the B. M. Collection, but there is a figure of *Heteronygmia stigmatica* Holland, from Gaboon, which appears to be near this species, but it has no black oblique postmedial line as in this species.

274. EUPROCTIS RUBRICOSTA, sp. n. (Pl. I. fig. 7.)

Description.—♂. Head, thorax, and wings pure shining white; antennæ bipectinate and ochreous, base of shaft white; legs thickly covered with long white hair. Abdomen with the first three somites white and the terminal three golden yellow. Underside white, with a red-brown band along the costa from base to just before apex.

Habitat. Masongaleni, 1911, 28th May, 1 ♂ ; 25th December, 1 ♀. Expanse 32 mm.

274 *a*. LACIPA ALBULA, sp. n. (Pl. I. fig. 8.)

Description.— ♂. Head, thorax. and wings pure shining white. Antennæ ciliate. Abdomen golden yellow with the exception of the first somite and the anal extremity, which are white. Fore wing unmarked, save for a shade on the costa beyond cell, and on inner margin before tornal angle. Eight black points on the margin between the veins, seven of which also appear on the hind wing. Underside: fore wing with the basal and internal area white, the costa and half of cell occupied by a red-brown band, and short reddish bands between the veins distally, above vein 3. The black marginal points more distinct than on the upperside.

Habitat. Masongaleni, 1911, 24th March, 1 ♂; 29th December, 1 ♂. Expanse 24 mm.

This form is near to *Lacipa sexpunctata* Distant, but is without the black spots and yellow ante- and postmedial lines.

Family GEOMETRIDÆ.

Subfamily BOARMIANÆ.

275. XYLOPTERYX ARCUATA Walker.

Habitat. Masongaleni, 21st June, 1911, 1 ♂.

276. HONORANA EREBARIA Guén.

Habitat. Kedai, 30th December, 1911, 1 ♀.

277. HYLEMERA LEPTA, sp. n. (Pl. I. fig. 29.)

Description.—♂. Head and pectus yellow. Thorax and first three somites of abdomen white above, yellow below, and concolorous with the terminal somites which are yellow. Fore wing white; the costa fuscous, and a broad apical fuscous fascia the inner margin of which is angled outwardly between veins 3 and 4. Hind wing white, with a very narrow fuscous border, which is almost linear, between veins 2 and 6.

Underside as on upperside.

Habitat. Kedai, 1911, 1st December, 1 ♂; 12th December, 1 ♀. Expanse 36 mm.

This species differs from *doleris* Plötz, *accra* Swinhoe, and *ansorgei* Warr., from Uganda, in the black band of the hind wing being narrow and continuous, the above forms having a large black spot on the apex of the hind wing: from *derithea* Druce, it differs in not having the inside of the fascia of the fore wing evenly curved, and a black spot below apex of hind wing.

278. EURRANTHIS PENNIGERARIA Hübner.

Habitat. Meru, B. E. Africa, taken by Lady Colvile.

Subfamily ACIDALIINÆ.

279. ACIDALIA SAGITTILINEA Warr. Nov. Zool. iv. p. 219 (1897).

Habitat. Kedai, 8th April, 1912, 1 ♂.

280. MICROLOXIA RUFICORNIS Warr.

Habitat. Kedai, 29th December, 1912, 1 ♀.

Subfamily GEOMETRINÆ.

281. TRIMETOPIA ÆTHERARIA Guén.

Habitat. Kedai, 1911, 4th January, 1 ♀; 23rd November, 1 ♂; 25th November, 1 ♀; 17th December, 1 ♂.

One of the most beautiful forms of Geometridæ.

282. **HETEROCRITA METIS**, sp. n. (Pl. I. fig. 30.)

Description.—♀. Head pinkish brown, the vertex between the antennæ white. Antennæ white above, pink beneath. Thorax and wings bright grass green. Abdomen pale pinkish brown above, ochreous on the under surface, the first two somites bright pinkish. Wings unmarked except for a bright pink-brown marginal line, inside which are two minute white spots defined inwardly by pinkish brown between veins 5 and 7, and a large one of the same colour at tornal angle of each wing. The inner margin of the hind wing also defined by a pinkish-brown line. Cilia pale pink. Underside glaucous grey.

Habitat. Kedai, 20th February, 1912, 1 ♀. Expanse 30 mm.

This form is near to, and may, perhaps, be a local race of *Heterocrita deprensa* Prout, from which it differs in (1) having no discoidal spots, (2) the spots at the tornal angles of both wings are much larger, and (3) the abdomen is much more pink-coloured.

283. **EURYTHECODES FLAVEDINARIA** Guén.

Habitat. Meru, B. E. Africa, taken by Lady Colvile.

Mr. Prout informs me that this is a common and very variable species, but I have only one specimen of it.

Family LIMACODIDÆ.

284. **THOSEA CANALE** Pagenstecher.

Habitat. Kedai, 1st December, 1911, 1 ♂.

285. **THOSEA UNDOSA**, sp. n. (Pl. I. fig. 6.)

Description.—♀. Head, thorax, and abdomen pale ochreous brown. Fore wing with the basal area as far as the postmedial line red brown, the distal area beyond it pale ochreous brown. Subbasal and antemedial lines absent; a black point at end of cell. A broad, dark brown oblique postmedial line, waved and irregular, from costa to inner margin at middle. A fine dark brown subterminal line from costa to tornal angle, where it almost meets the black marginal line. Cilia pale brown in both wings. Hind wing ochreous brown, with a brown marginal line. Underside ochreous brown, irrorated with red brown atoms.

Habitat. Kedai, 4th December, 1911, 1 ♀. Expanse 30 mm.

This form is nearest to *T. cana* Walker (=*transversata* Walker) from India, in which the dark line is antemedial, less oblique, and straight without waves; the subterminal line is straight, and not curved, and the basal area is not so dark as in this species.

286. **THOSEA PERSEIS**, sp. n. (Pl. I. fig. 4.)

Description.—♂. Head, thorax, abdomen, and fore wing red-brown minutely irrorated with black atoms. Subbasal and antemedial lines absent. A white point at end of cell. A black highly-waved postmedial line from costa before apex to middle of inner margin, which is inwardly diffused into black patches below end of cell, and from vein 2 to inner margin. This line is outwardly defined by a prominent white line, with dark shades beyond it between veins 2 and 3 and 6 and 7. An irregularly curved subterminal line followed by a black marginal line. Cilia of both wings red-brown. Hind wing ochreous. Underside ochreous, with indications of a postmedial line.

Habitat. Masongaleni, 30th April, 1911, 1 ♂. Expanse 30 mm.

This form is nearest to *T. syrtis* Schaus, from Salisbury and West Africa. It differs in the lines being waved and not straight, and that species has not the dark patches inside the postmedial line. When at the B.M. I submitted the above specimens to the inspection of Lord Rothschild, who said the forms were unknown to him, and differed from described forms mainly in their undulating lines.

287. THOSEA CHLORIS, sp. n. (Pl. I. fig. 5.)

Description. ♂. Head and thorax red-brown beneath, fiery orange dorsally. Abdomen red-brown, with some fiery-orange hairs on the dorsum. Tibiæ fiery orange, with long red-brown hairs to the tarsi. Fore wing red-brown with pinkish suffusion. A white point at end of cell. No subbasal or antemedial lines. Postmedial line dark brown, from costa before apex to middle of inner margin. Subterminal area paler. Subterminal line from costa before apex to outer margin at vein 3. Two whitish spots between veins 2 and 3: one outside the postmedial line, and one on inside of subterminal line, near its junction with outer margin. Hind wing red-brown paling to ochreous at base. Underside pale red-brown unmarked.

Habitat. Ashanti, W. Africa (*A. Norris*), 1 ♂. Expanse 30 mm.

This form is nearest to *T. rara* Swinhoe, from Thyetmyo, Burma, but is darker red, and has fiery orange head and thorax which *rara* has not. In the B. M. Collection there is an unnamed specimen from the Gold Coast, which may or may not be referable to this species.

288. COSUMA MARGINATA Holland.

Habitat. Masongaleni, 7th April, 1911, 1 ♂.

This form seems near to the following which I have from W. Africa.

289. COSUMA RUGOSA Walker.

Habitat. Ashanti, W. Africa (*A. Norris*), 1 ♂.

290. APLUDA INCINATA Hampson.

Habitat. Masongaleni, 1911, 2 ♂.

291. GAVARA VELUTINA Walker.

Habitat. Kedai, 1912, 16th March, 1 ♂ ; 10th December, 1 ♀.

I identified these specimens in the B. M. as above; there are however, two forms of Limacodidæ which have passed as "*velutina*," and are given by Hampson in Faun. Brit. Ind., Moths, i. pp. 382 & 398, which are very different-looking insects from the present form.

292. ALTHA LACIDES Druce.

Habitat. Masongaleni, 1911, 25th December, 1 ♂ ; 2nd April, 1 ♀.

Family ARBELIDÆ.

293. ARBELODES TETRASTICTA Hampson.

Habitat. Kedai, 12th January, 1912, 1 ♂.

This specimen only differs from the specimen in the B. M., which is also from British East Africa, in the body being somewhat shorter, and the pale markings of the wings being larger.

Family COSSIDÆ.

*228. DUOMITUS PINDARUS Fawcett, P. Z. S. 1916, p. 733. (Pl. I. fig. 27.)

I am now able to give a figure of this species, which was omitted from my last paper from want of space in the plate.

Comparison of fignre 27 with that of *D. steniptera* Hampson, P. Z. S. 1916, plate ii. fig. 31, will show how much it differs from that species both in colour and size.

Family THYRIDIDÆ.

294. RHODONEURA DRYAXIS, sp. n. (Pl. I. fig. 9.)

Description.—♀. Head, thorax, and abdomen ochreous suffused with rufous. Fore wing reddish ochreous profusely striated with rufous. Antemedial line indistinct. Postmedial line bifid on the costa, originating from two costal spots, and bent in obliquely on veins 2 and 3. Subterminal line very prominent, from costa before apex, angled outwards to outer margin at veins 4 and 2. Hind wing with a medial double line, a postmedial line, and a subterminal line angled to outer margin at veins 4 and 2.

♂. Smaller and paler in coloration, being pale ochreous. The postmedial line on the fore wing and the medial line on the hind wing double and filled in with rufous; otherwise as in ♀.

Habitat. Kedai, 1911, 26th November, 1 ♂ ; 15th December, 1 ♂. 1912, 13th January, 1 ♀ ; 12th March, 1 ♀ ; 8th December, 1 ♂. Expanse, ♂ 28 mm.; ♀ 30 mm.

This form differs from all the specimens of *Rhodoneura* in the B. M. Collection in its prominent subterminal line angled to outer margin at veins 4 and 2.

295. DYSODIA INTERMEDIA Walker.

Habitat. Kedai, 5th January, 1912, 1 ♂.

The above example agrees with B. E. African specimens in the B. M. Collection which were collected at Taveta by Rogers in October and at the end of December, and named *flavillula* by Warren, and which Sir George Hampson evidently regards as forms of Walker's South African species.

Family PYRALIDÆ.

Subfamily CRAMBINÆ.

296. SURATTHA RUFISTRIGALIS, sp. n. (Pl. I. fig. 3.)

Description.—♂. Head, body, and legs ferruginous. Fore wing brownish ochreous, ferruginous on costa. Highly dentate medial and postmedial ferruginous lines from costa to inner margin, angled outwardly at vein 5. A ferruginous terminal line with dark wedge-shaped spots between the veins. Median nervure and inner margin defined by bright ferruginous bands; the interspaces between the veins defined with fuscous irroration. Hind wing ochreous, with ferruginous irroration in the subapical area: cilia ochreous.

Habitat. Kedai, 18th November, 1911, 1 ♂. Expanse 24 mm.

The figure is slightly larger than natural size.

This form is nearest to *S. africalis* Hampson, but has no dark medial area; the postmedial line is more dentate, and the coloration is brighter ferruginous.

297. ANCYLQLOMIA SIMPLELLA De Jaan.

Habitat. Meru, B. E. Africa, taken by Lady Colvile, 1 ♀.

298. ANCYLOLOMIA PECTINIFERA Hampson.

Habitat. Kedai, 9th January, 1913, 1 ♀.

Also recorded from Somaliland.

299. ANCYLOLOMIA CHRYSOLINEALIS, sp. n. (Pl. I. fig. 2.)

Description.— ♂. Head, thorax, abdomen, and fore wing very pale ochreous. Fore wing with eight golden stripes in the interspaces between the veins in the distal area beyond the cell, of which those in interspaces 1 and 7 are shorter than the remainder. Each golden stripe is defined beneath by a yellow fascia with streaks of black scales on it. A minutely dentate silvery submarginal line on which are some dusky points. Cilia silvery. Hind wing pure white; cilia white. Underside as on upperside, with silvery suffusion.

Habitat. Masongaleni, 26th December, 1911, 1 ♂. Expanse 34 mm.

This form is nearest to *A. chrysographella* Kollar, from India, but is distinguished by having the golden stripes of the fore wing confined to the distal area, and it is considerably larger than *chrysographella*.

300. ANCYLOLOMIA GRACILIS, sp. n. (Pl. I. fig. 1.)

Description.—♂. Head, thorax, and abdomen pale ochreous brown. Fore wing bright ochreous, unmarked; the interior marginal area below vein 1 thickly irrorated with fuscous scales. A series of black points at the end of the veins on the outer margin. Hind wing silvery grey, with ochreous suffusion on the subapical area. Cilia ochreous. Underside as on upperside, with silvery suffusion.

Habitat. Meru, B. E. Africa, taken by Lady Colvile, 1 ♂. Expanse 28 mm.

There is a series of unnamed specimens in the B. M. Collection, which appear to be very near this species.

Subfamily ANERASTIANÆ.

301. EMATHEUDES LENTISTRIGALIS Hampson.

Habitat. Masongaleni, 6th June, 1912, 1 ♀.

New Forms from other Regions.

Family LYMANTRIADÆ.

302. ANTHELA NIGRISTIGMA, sp. n. (Pl. I. fig. 28.)

Description.—♂. Vertex of head and collar ferruginous; thorax pale red-brown; abdomen ochreous. Wings pale ochreous with golden suffusion in certain lights. Base of fore wing and internal area of hind wing clothed with long pale red-brown hair. Fore wing with a round black spot in centre of cell, and a larger quadrate black spot on discocellulars. A somewhat indistinct line of submarginal black points on the veins in the subterminal area. Hind wing with a quadrate discocellular black spot, and a submarginal series of black points on the veins.

Underside concolorous with upperside, with an additional black spot in the cell of the hind wing which does not appear on the upperside, and all the black spots have whitish centres. Cilia ochreous.

Habitat. Townsville, Queensland, Australia, August 1913, 1 ♂. Expanse 36 mm.

The above specimen was sent to me by Mr. Feather in a small collection from Australia. In the B. M. Collection there is a series of unnamed specimens which may, or may not, be referable to this species. In some of them the cellular spots are a good deal larger and the submarginal series more distinct. This species is near to *ocellata* Walker, which has the submarginal spots black and prominent.

Family NOCTUIDÆ.

Subfamily CATOCALINÆ.

303. NYCTIPAO ACUTA, sp. n. (Pl. I. fig. 26.)

Description.—♂. Head, thorax, and abdomen fuscous brown. Fore wing with the basal two-thirds very dark red-brown, the subterminal third pale red brown with pinkish suffusion, profusely striated with red-brown. Apex of fore wing acute. Antemedial line obsolescent, and hardly distinguishable. An inverted comma-shaped discoidal whorl with bilobate head defined by black, and its head by silvery blue with a red brown patch beyond it; its centre reddish brown with an ochreous line on inner side of tail. Medial line black, arising below the costa, excurved round the discoidal whorl, and angled inwards below it on vein 2, and then erect to inner margin. This line is defined outwardly by a pale round ring beyond the whorl. Postmedial line curved, starting from a large triangular black patch below the costa and continued as an indistinct fuscous line to below vein 2, where it forms the outer edge of the basal dark area to inner margin. This line is defined outwardly by a narrow ochreous line from costa to below vein 7, and thence to inner margin by an indistinct line of the ground-colour. Subterminal line obsolete. Hind wing with the basal two-thirds dark red-brown, the terminal third pale red-brown with pinkish suffusion; the postmedial line represented by double fine lines of the ground-colour; subterminal line represented by an indistinct, waved, subterminal shade. Cilia pale red-brown.

Underside of both wings fuscous brown; fore wing with a white postmedial patch from below costa to vein 6, where it is broadest. A subterminal series of white oblong spots, incurved in interspace 4, excurved in interspace 3.

♀. Similar to ♂, but the comma-shaped discoidal whorl is somewhat larger, and there is a pale ochreous postmedial patch from costa to just above vein 6, diffused outwardly.

This form has, I think, been overlooked by later writers; I say this because I cannot find amongst the described forms in C. L. P. vol. xii. (published in 1913) a description and figure that absolutely tallies with my specimens. The nearest to it is *Nyctipao gemmans* Guén. It differs from all the forms of *Nyctipao* which I have seen in having the apex of the fore wing acute. The form *crepuscularis* Linn. is nearest to it in this respect, but its outer margin is highly crenulate, whereas in this species it is evenly rounded. From *gemmans* in particular it differs in the absence of the white postmedial line, which is represented by a short ochreous striga below the costa.

Habitat. Hills E. of Toungho, Burma, May 1896, 1 ♂, 1 ♀. Expanse 74 mm.

The above specimens were taken by some native Lepcha collectors sent to the Burma hill-country to collect Lepidoptera by Mr. F. Möller, Mr. J. Apcar, and myself.

EXPLANATION OF THE PLATE.

Fig.
1. *Ancylolomia gracilis*, ♂.
2. *Ancylolomia chrysolinealis*, ♂.
3. *Surattha rufistrigalis*, ♂.
4. *Thosea perseis*, ♂.
5. *Thosea chloris*, ♂.
6. *Thosea undosa*, ♀.
7. *Euproctis rubricosta*, ♂.
8. *Lacipa albula*, ♂.
9. *Rhodoneura bryaxis*, ♀.
10. *Syntomis polyxo*, ♂.
11. *Bithra aganice*, ♀.
12. *Cladocerotis æneus*, ♂.
13. *Cynisca thisbe*, ♀.
14. *Giaura arethusa*, ♂.
15. *Odontestra aritta*, ♂.
16. *Heteronygmia aurelia*, ♂.

Fig.
17. *Cortyta minyas*, ♂.
18. *Cortyta grisacea*, ♂.
19. *Rhodesana mintha*, ♂.
20. *Leocyma candace*, ♂.
21. *Pteronycta cervicornis*, ♂.
22. *Parastichtis oxylus*, ♂.
23. *Plecoptera polymnia*, ♀.
24. *Brevipecten icarus*, ♂.
25. *Parastichtis lysis*, ♂.
26. *Nyctipao acuta*, ♂.
27. *Duomitus pindarus*, ♂.
28. *Anthela nigristigma*, ♂.
29. *Hylemera lepta*, ♂.
30. *Heterocrita metis*, ♀.
31. *Ctenusa rectilinea*, ♂.

16. Deformity of *Os penis* in a Seal (*Phoca caspica* Nilsson).

By SERGIUS ALPHÉRAKY *.

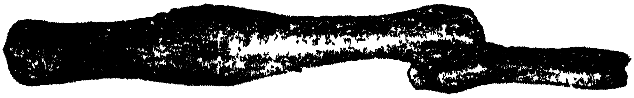
[Received October 5, 1917 : Read November 20, 1917.]

(Text-figure 1.)

My friend Mr. T. N. Arnold, our well-known ichthyologist, has kindly lent me for description an abnormal *os penis* of an adult *Phoca caspica* he himself shot a few years ago on the Caspian Sea.

This abnormality is evidently due to an accidental fracture at about the first third part of the total length of the bone. That the bone has here been broken in some way, and has again united with the portions in a distorted position, can clearly be seen from the accompanying drawing, made by my son Dmitry Alphéraky. The drawing shows the bone from above, and as it is very exact in form and size, I think it gives a better idea of the malformation than could be given by any amount of description.

Text-figure 1.



The fractured part is so strongly and solidly united with the main part of the bone, that the fracture must have taken place a long time prior to the animal's death.

It is difficult to find a satisfactory explanation of the cause of such a fracture, and Mr. Arnold thinks that it may have been the sequel of some violent movement of one of the animals during the act of copulation.

As far as Mr. Arnold remembers, the penis outwardly had no signs, or scars, to show that anything was amiss inside, and the deformity was discovered only during the cleaning of the bone. This was not an easy thing to do, as the apical part of the bone had the cavernous integument round it strongly adherent. This apical part of the bone has now a very rough, porous, uneven surface, showing that the erectile tissue had been deeply embedded.

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* Communicated by Mr. O. THOMAS, F.R.S.

17. Some Observations upon Concealment by the apparent Disruption of Surface in a Plane at Right Angles to the Surface. By J. C. Mottram, M.B. (Lond.) *.

[Received October 22, 1917. Read November 6, 1917.]

(Text-figures 1-4.)

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The forms of animals are often rendered inconspicuous by the methods which the artist usually employs in the representation of three dimensions on a flat surface.

Attempt is here made to show, first, what use the artist makes of Simultaneous Contrast for the apparent disruption of the surface of his paper or canvas: and subsequently to ascertain whether similar arrangements occur in the patterns of animals.

The Artist's Use of Simultaneous Contrast.—When a dark object is viewed against a light background or *vice versa*, it will be seen that where the dark and light areas join, the dark tone appears darker than the rest of the dark area, and the light, lighter than the remainder of the light area.

The same appearance will be seen on the artist's paper if he copies exactly the tones of the original. If, however, he exaggerates the contrast by surrounding dark objects with dark lines and light objects with light, then the objects will appear to stand out from the background, and different portions of his paper to occupy different planes. For this purpose, foreground figures are often surrounded with dark lines, clouds are edged with light tone, and trees against the sky are outlined with black, whilst the neighbouring sky is greatly heightened in tone.

It is not uncommon to find a series of receding hills outlined with dark lines of gradually decreasing intensity: it is remarkable how realistically distance is thus represented.

The introduction of dark tone between coloured areas results in disruption of surface for another reason. On viewing the junction of two coloured areas, there will be seen for a short distance a flowing-over of each colour into its neighbour. This is well seen by drawing a narrow white line across red and blue surfaces: where the white lies on the red, it appears reddish, where on the blue, light blue. If the white line be surrounded on both sides with black lines, then this flowing-over is prevented and the white line retains its purity. By thus preventing this blending, coloured areas in juxtaposition have the appearance of standing out, one from the other, and occupying different planes.

---

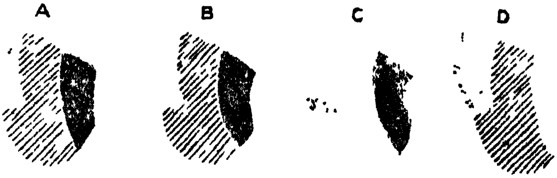
* Communicated by the SECRETARY.

These appearances may be explained in another manner. The mind largely recognises objects by their outline, and to some extent judges their distance by its sharpness. If in representing objects on a flat surface, they be edged with white or black lines, then the sharp outline thus given will make them appear nearer the eye than their surroundings, and the flat surface appear to be disrupted in a plane at right angles to the surface.

Surface Disruption in Animal Pattern.—Concealment in the animals consists chiefly in the hiding of outline, solidity, and surface. Outline is largely concealed by "Disruptive Coloration," solidity by "Counter Shading."

"Disruptive Coloration" conceals outline in the following manner: when an animal covered with a number of large patches of different tone and colour comes to rest on a background which harmonises with any one of the components, then its characteristic outline will be broken, as shown in text-fig. 1.

Text figure 1.



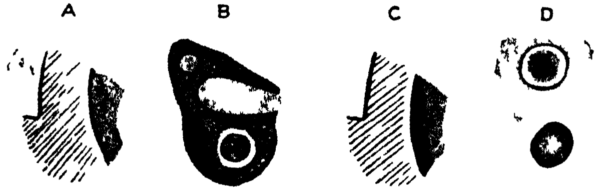
Disruptive Coloration· A, a pattern of three components which largely interrupt the margin. B, the appearance when seen against a background harmonising with the spotted component, C and D when seen against a striped and a plane background.

The disruption is in the same plane as the wings of the insect, and is dependent upon a pattern breaking out over a large portion of the margin.

Disruption of surface consists in an arrangement of pattern and coloration, which causes some portion of the surface to appear close to the eye, and others far away. In this case the disruption is in a plane at right angles to the plane of the object. As has already been shown, this can be produced by the use of Simultaneous Contrast and, thus brought about, may be termed Surface Disruption by Contrast. "Outline Disruption" and "Surface Disruption by Contrast" are often combined as shown in text-fig. 2 A (compare text-fig. 1). Text-fig. 2 B illustrates an insect showing only Surface Disruption.

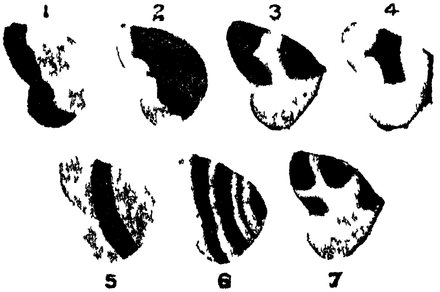
An examination of British Lepidoptera is now made in order to estimate to what extent this method is employed for purposes of concealment. It may be said with confidence, that the whole of the Geometers in respect of the dorsal surface of their wings, of the Noctuas with regard to the dorsal surface of their anterior wings, and of the Rhopalocera in respect of the ventral surface of their posterior wings, present concealing pattern and coloration. Here, therefore, "Surface Disruption by Contrast" may be looked for.

Text-figure 2.



A a pattern similar to that shown in text fig 1, but with the addition of Surface Disruption produced by light and dark lines between the components, in C the surface is further disrupted by the representation of solidity. B shows "Surface Disruption by Contrast" not associated with disruption of outline. This is rarely found. *Thyatira batis* is a good example. D shows the combination of Surface Disruption by Contrast with Surface Disruption by Solidity. Large ocelli generally appear to be of this nature.

Text figure 3.



Shows in diagram seven types of pattern commonly found in Geometers and other Lepidoptera, in which Surface Disruption by Contrast is combined with Outline Disruption. Many variations occur of type no 6, in some cases the bands are wavy or zigzag, more especially in the fore wings of Noctuidæ.

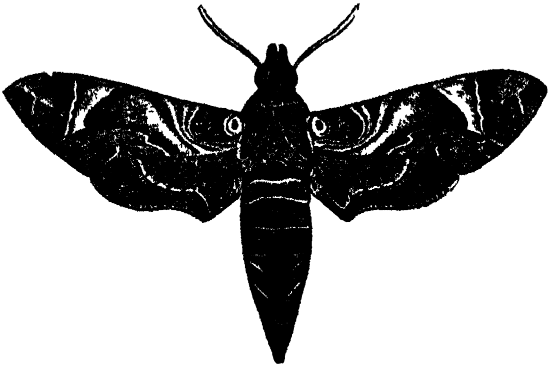
An examination of the Geometridæ (Newman) shows that surface disruption occurs, associated with well-marked types of outline disruption. These are illustrated diagrammatically in text-fig. 3, and are seen to consist of well-defined bars of tone interrupting the margin and which are separated from the rest of the insect's wing by distinct black or white lines (only black lines are shown in the diagrams).

The distribution of these types is given in the Table on p. 257, where it can be seen that "Surface Disruption by Contrast" occurs in the Geometers in 69 out of 276 insects. In the Noctuas the patterns occur 34 times in 311 insects, in the Cuspidates 11 in 33, and in the Rhopalocera 10 in 60.

It follows that this method is often used for purposes of concealment amongst the Lepidoptera; numerous examples are also to be found in the patterns of Vertebrates.

Surface disruption can also be produced by the representation of solid objects on a flat surface: this, indeed, is the method chiefly employed by the artist. This method is very often found in the pattern of animals generally combined with "Outline Disruption" and "Surface Disruption by Contrast." Examples are shown in text-fig. 2, C and D; in C all three methods are combined, in D surface disruption by solidity with contrast. No better example of such combinations of methods can be found than *Chærocampa nerii* illustrated in text-fig. 4; in this insect the components of the pattern break out at the margin, are shaded to represent excrescences and depressions, and are separated from each other by well-defined white and black lines.

Text-figure 4.



The Oleander Hawk-Moth (*Chærocampa nerii*). From 'The Natural History of British Butterflies and Moths,' by Edward Newman, F.L.S., F.Z.S. See text below: reference is made only to the fore wings; the hind wings are more or less concealed by the fore wings in the position of rest.

Opportunity is here taken to call attention to the fact that many small details of pattern are of value in concealment; it would seem dangerous therefore to conclude on negative evidence, that small differences such as often distinguish species can have no value in the struggle for existence.

TABLE *

Types in text-fig. 3	Geometers	Noctuas	Cuspidates	Rhopalocera
1	3		1	3
2	1		2	4
3	4	2	1	
4	10	8	3	3
5	25	7	4	
6	21	15		
7	5	2		
Total	69	34	11	10
No. of species	276	311	33	60

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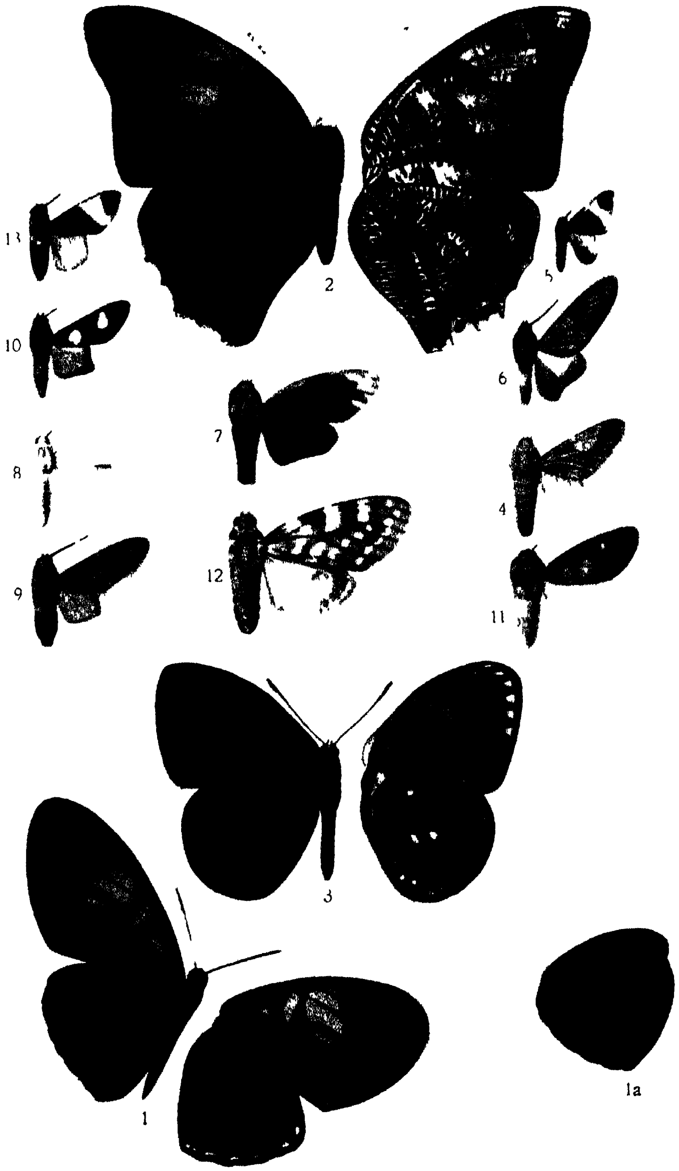
* Compiled from Newman, 'The Natural History of British Butterflies and Moths.'

P Z S 1917 TALBOT & JOICEY. Pl I.



Horace Knight del. MINTERN BROS. WATFORD

LEPIDOPTEROUS ABERRATIONS
NEW SOUTH AMERICAN ARCTIIDÆ

18. New South-American Rhopalocera. By J. J. Joicey, F.L.S., F.Z.S., F.E.S., and G. Talbot, F.E.S.

[Received June 20, 1917: Read November 20, 1917.]

(Plate I.*)

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The types of the forms herein described are in the collection of Joicey.

Papilionidæ.

Papilio erlaces chinchipensis, subsp. n.

♂. Upperside like typical *erlaces* Gray. Underside with spots as in *lacydes* Hew.

♀. Resembles *lacydes* but with no post-discocellular spots.

This race connects *erlaces erlaces* with *lacydes* through *xanthias* R. & J.

Hab. North Peru - Chinchipe River, Sept., 17 ♂ ♂, 6 ♀ ♀; Charape, 4000 feet, 2 ♀ ♀; Tabaconas, 6000 feet, 2 ♂ ♂. These places are on the eastern slopes of the Andes. Collected by A. E., & F. Pratt.

Papilio iphidamas ayabacensis, subsp. n.

Nearest to the race *calogyna* Roths. & Jord., from West Ecuador and Colombia.

♂. Upperside with reduced green patch on the *fore wing*. *Hind wing* with three red spots, all separate.

Underside of *hind wing* with the spots smaller and more widely separate; ground-colour not so black and browner than in *calogyna*.

♀ similar to *calogyna* ♀, but band of hind wing much whiter and with an extra spot in cellule 6, similar to a specimen in the Tring Museum from Zaruma, S.W. Ecuador, which has the band of the hind wing half white.

Hab. North Peru—Ayabaca Mtns., 6 ♂ ♂, 2 ♀ ♀; River Tabaconas, 6000 feet, 1 ♂. Collected by A. E., & F. Pratt.

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* For explanation of the Plate see p. 276.

PAPILIO HARMODIUS TABACONAS, subsp. n.

Near the race *xeniades* Hew., from Ecuador.

♂ like *harmodius* Doubl., but with a narrower white patch on the *fore wing*, straighter on its proximal edge.

♀ with no constant difference.

A ♂ in the Tring Museum from Zamora, S.W. Ecuador, occurring as an aberration with typical *xeniades*.

The ♀ presents a strong resemblance to the ♀ of *P. erlaces chinchipensis* found in the same district.

Hab. North Peru—River Tabaconas, 6000 feet, 12 ♂ ♂, 1 ♀ (types); Charape, 4000 feet, 27 ♂ ♂; Ayabaca Mtns., 1 ♀; Rentema Falls, Upper Maranon, 1000 feet, 1 ♂. Collected by A, E, & F. Pratt.

PIERIDÆ.

LEODONTA ZENOBIA MONTICOLA, subsp. n.

♂. A larger race with deeper yellow markings.

Upperside of *fore wing* with the two post-discocellular spots farther from the cell, there being a wider space between the lower spot and the one in 3; the subterminal spot in 3 is larger.

Underside with a larger cell-patch, which extends basad beyond vein 2; patch below vein 2 slightly more extended basad. *Hind wing* with no constant difference.

Length of fore wing 30–34 mm.; in *zenobia zenobia* it averages 29 mm.

Hab. Uruhuasi, S.E. Peru, 7000 feet, April to May, 1910. H. & C. Watkins. 5 ♂ ♂.

CATASTICTA PHILONE NIMBATA, subsp. n.

♂. Upperside very similar to *philone* Feld. from Colombia, but basal markings less well-defined.

Underside of *fore wing* with the three anterior spots of the discal band smaller. *Hind wing* with the discal white band much narrower in the cell and below it; the yellow spots deeper in colour.

This race is not well differentiated.

Hab. Peru, 1 ♂.

This and the following forms of *Catasticta* were received from Monsieur E. Le Moult of Paris.

CATASTICTA FLISA TAMBOENSIS, subsp. n.

♂. Upperside more brown than black. *Hind wing* with the band narrowed in the cell and postdiscal spots minute.

Underside of *fore wing* with cell-spot larger; spots of postdiscal row larger and nearer the margin, distally concave, forming lunules. *Hind wing* with precostal area white, discal band widened costally; outer subterminal area more washed with white; marginal spots yellow, large, and triangular, their apices almost touching the postdiscal spots.

Hab. Peru, 1 ♂.

This form is probably the same as the specimen recorded as *flisa* H.-Sch. by Weymer & Maasen, Lepidoptera, p. 73 (1890), from Tambo Almirante. We do not know another record of this species from Peru.

CATASTICTA LATHYI, sp. n.

Allied to *philais* Feld., from Colombia.

♂. Colour above nearly as in *manco* Doubl. and pattern similar, but easily distinguished by the brown margin of the *hind wing* and different underside. Differs from *philais* above in colour, *philais* being brown; the pattern is the same, but the dark margin of the hind wing is broader.

Underside of *fore wing* with reduced cell-streak; marginal spots smaller but more produced proximally, forming streaks; the spots of the postdiscal series are smaller. These markings, which are brown in *philais*, are here grey-white. *Hind wing* with markings very much as in *philais*, but the yellow intraneural distal streaks longer.

Length of fore wing 26 mm.

Hab. Loja, Ecuador, 1 ♂. Also in the Tring Museum from the following places: Loja; Zamora, Ecuador, 3000 4000 feet; Cushi, Huanuco, Cent. Peru, 1820 m.

CATASTICTA NIMBICE PERUVIANA, subsp. n.

♂. Distinguished by the more rounded wings and paler markings. The discal spot in 4 on the *fore wing* is much smaller than the spot above it; spots in 7 and 8 absent; postdiscal spot in 3 shifted inwards; no marginal dots. *Hind wing* with the pale band widened and its outer edge nearer the postdiscal spots; spot in 3 shifted inwards; spots in 2 and 4 farther from the band than the others.

Underside of *fore wing* with the band, cell-spot, and lower five postdiscal spots pale straw-colour. *Hind wing* with the discal band reduced distally, the spot at base of 2 being smaller, and widened proximally; postdiscal and marginal spots larger. The markings which are orange-yellow in *nimbice* are bright yellow in *peruviana*.

Hab. Peru, 1 ♂

NYMPHALIDÆ.

A remarkable new species of the Nymphaline genus *Vila*.

VILA EUEIDIFORMIS, sp. n. (Pl. I. figs. 1, 1 *a*.)

♂. Upperside black-brown. *Fore wing* with pale yellow markings. A basal wedge-shaped streak in lower part of cell; a wedge-shaped spot in end of cell, placed transversely, its pointed end posteriorly; a large, somewhat quadrate spot beyond end of cell divided by vein 5, the lower part in 4 larger than the upper, the inner edge slightly curved; a small spot above it in the angle of 6; an elongate oval spot below it at base of cellule 3. *Hind wing* paler in the costal area. A black patch of androconia in base of cellule 7, 9 mm. long. Red basal streaks in 1 *a*, *b*, *c*, and in the cell. In a second specimen, from Bolivia, they are a little reduced, but in a third, from the Upper Amazon, the red streaks are greatly enlarged and more extended, the one in the cell filling its base and whole upper part, forked at the end and forming two short streaks in 4 and 5; there are also two additional short streaks in 2 and 3.

Underside with paler ground-colour. *Fore wing* with markings as above, and a white dot at base of costa. The black patch of androconia, common to all members of the genus, is longer than in other species and does not touch the median vein; it is placed obliquely in the submedian area, whereas in other species it is parallel to vein 2; the inner margin is shining grey; a white subterminal line from tornus to vein 2 and represented above this vein by a few scales. In the species with increased red on hind wing above, the basal fore-wing stripe is only represented by a few scales. *Hind wing* with brick-red stripes between the veins; base of costa and precostal area brick-red, joined to a stripe bordering vein 8 in 7; stripes in 1 *c*, 2-6, nail-headed distally, the one in 4 joined to a broader cell-stripe, stripe in 1 *a* filling the cellule; a subterminal series of white spots between the veins. In the specimen with increased red on hind wing above, the stripes are broader below.

Antennæ black-brown, club and inner surface yellow-brown; palpi black, first and second segments white at sides; head, thorax, and abdomen black, collar with white dots; abdomen below dark brown, legs dark brown, coxæ with white tufts.

Length of fore wing 35 mm.

Hab. Jurua River, Brazil (type and paratype); Bolivia (1 ♂). This latter locality is doubtful.

We propose the name *radiata* for the aberration with increased red rays on the hind wing above (Pl. I. fig. 1 *a*).

This species agrees in structure with other species of the genus, possessing the characteristic inflated basal part of the costal vein of the fore wing, and also the curved lower discocellular touching the cell before vein 3. In pattern, its relationship with other species may perhaps be traced in the fore-wing cell-streak, the white mark at base of costa on fore wing below, the white subterminal mark near tornus, the red subcostal stripe on hind wing below, and the series of white spots which may represent the subterminal line. The colour of the palpi and antennæ also shows affinity with other species.

The chief feature of this species lies in its remarkable mimetic resemblance to the Heliconine genus *Eueides* as represented by *E. eanides* Stich. and its form *aides* Stich., which inhabit the same region. The form *eanides* is mimicked by the specimen with increased red rays on the hind wing above. The hind-wing underside, with its rayed pattern and marginal row of white spots, shows the greatest resemblance. It also bears a strong likeness to *Pericopis mimica* Feld., a day-flying Hypsid moth, which occurs from Colombia to Peru. In a lesser degree, the species also resembles two forms of the Nymphaline genus *Eresia*, represented by the darker specimens of *E. perilla* Hew. and *cornelia* Stgr. The diversity of co-existent mimetic forms, seen in the species of *Eresia*, is analogous to the wide departure from the normal form now seen to occur in the genus *Vila*.

The typical forms of *Vila* possess a somewhat Ithomiine-like pattern, but more nearly resemble some white-banded forms of *Eresia*, the likeness being marked on the underside of the hind wing. Ithomiines would probably serve as models for *Vila* on the wing, and in such a white-banded association would be included *Adelpha epione* Godt. Another *Adelpha*, *coryneta* Hew., resembles *Vila azeca* D. & H. on the hind wing below, as also does *Eresia clio* L.

We have, therefore, a mimetic association of *Vila eueidiformis* with *Eueides*, *Eresia*, and *Pericopis*, and another association of *Vila azeca* with Ithomiine species and the Nymphalines *Adelpha* and *Eresia*. It would appear probable that the resemblance of *Vila* to Ithomiines and *Adelpha* would be most marked when on the wing, whilst presumably the resemblance on the hind wing below between *Vila azeca*, *Eresia clio*, and *Adelpha coryneta* would be sufficiently marked when at rest.

No doubt the white-banded Ithomiines, probably of the genus *Leucothyris*, have served as models, as they are more abundant than the Nymphalines. *Adelpha* is fairly common, and so are the white *Eresia*, but *Vila* is comparatively rare.

The Female of POLYGRAPHA CYANEA G. & S.

(Pl. 1. fig. 2.)

The male of *Polygrapha cyanea* Godm. & Salv. is not rare in collections, but no description of the female seems to have been published. We describe it from the only specimen which we believe to exist in collections. This specimen, which is much damaged, was taken by Mr. W. F. H. Rosenberg's collector, Mr. G. Palmer, at Alpayacu, Rio Pastaza, E. Ecuador, 3000 feet, and was found drowned in a native "Chicha" pot outside a house. The collection containing the specimen was acquired by the late Mr. Herbert Druce.

Upperside with dark brown ground-colour. *Fore wing* with yellow-brown oblique band from vein 4 to the inner margin near tornus; the band is much broader in cellules 2 and 3 and its inner edge is incurved in cellule 2 and in 1 *b*, the outer edge is evenly curved outwardly; a pale brownish streak at base of cellule 6, and beyond this the costal area whitish brown, not extending to the base nor distally beyond the streak in 6; a small triangular brown spot in 5 in the distal area. *Hind wing* with a yellow-brown costal edge and apical suffusion; a series of yellow-brown subterminal spots, well-defined proximally, but distally suffused; outer margin narrowly edged with yellow-brown. Underside marked as in the ♂, but the specimen being rubbed we cannot distinguish any differences in colour.

Head and antennæ missing. Thorax and abdomen black-brown.

Length of fore wing 41 mm.

The completely different pattern presented by the female of this insect suggests some sort of mimetic resemblance. It presents a great similarity to the pattern of many species of the Brassolid genus *Opsiphanes*, four species of which, with brown bands on the fore wing, are recorded from Ecuador and Peru. Mr. W. J. Kaye informs us that *Opsiphanes* fly round the houses at dusk, and this observation, coupled with the fact that the female *Polygrapha* was found in a water-pot near a house, points to the possibility of the two insects flying in company.

19. New South-American Arctiidæ. By J. J. Joicey, F.L.S., F.Z.S., F.E.S., and G. Talbot, F.E.S.

[Received June 20, 1917 Read November 20, 1917.]

(Plate I.*)

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The types of the species herein described are in the collection of Joicey. Our thanks are due to Sir G. F. Hampson for kind help given.

1. IDALUS FLAVITHORAX, sp. n. (Pl. I. fig. 4.)

Nearest *flavoplaga* Schaus.

♂. Both sides of *fore wing* pale purplish brown; veins white. A large pale-yellow distal costal patch, extending to below vein 4 and filling end of cell, its outer edge parallel to margin and as long as its costal edge. Inner margin with a yellow stripe on its outer half, the edge of the stripe curved above the submedian. *Hind wing* pale yellowish white, costa and margins more deeply tinted.

Head, thorax, and abdomen ochreous-yellow, three end segments of abdomen above black fringed with grey, below yellow excepting end-segment. Antennæ white above, brown below. Palpi greyish-white. Legs white, coxæ of fore-legs yellow. Length of fore wing 15 mm.

Hab. S. Brazil, Rio Grande do Sul. A single specimen.

2. NEONERITA METAPHŒNICA, sp. n. (Pl. I. fig. 5.)

Nearest to *yahuasæ* J. & T., Ann. & Mag. N. H. ser. 8, vol. xviii. p. 54, pl. xiv. fig. 3 (1916) (Peruvian Amazon).

♂. Differs from *yahuasæ* in its smaller size, broader band on the *fore wing*, and *hind wing* washed with crimson except over the apical area. Antennæ, thorax, and abdomen above crimson, the thorax being much duller with a greyish admixture. Length of fore wing 9 mm.

Hab. French Guiana, St. Jean du Maroni, 1 ♂.

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* For explanation of the Plate see p. 276.

3. **Aræomolis nigripuncta**, sp. n. (Pl. I. fig. 6.)

Near *sanguinea* Hamps.*, but more strongly irrorated with yellow, the discal line strongly curved, and the three subapical spots placed in a curve.

♂. Upperside of *fore wing* crimson, strongly irrorated with yellow. Costal edge greyish white for proximal two-thirds. Markings yellowish grey tinged with crimson. Three ill-defined basal spots edged with blackish outwardly, the upper one in the cell; a discal band of spots, its inner edge strongly curved and defined by blackish dots, its outer edge irregular, though the upper part defined by blackish dots forms a curve to below vein 3; below this the band is much narrower and reaches the tornus; anteriorly it is limited by the subcostal and is composed of a double spot in the end of the cell, three outside the cell and five below it; three subapical spots forming a curve, and below the third two smaller and darker spots parallel to the margin; the termen marked by black dots at the ends of the veins. *Hind wing* with distal area salmon-pink, the discal and basal area being hyaline.

Underside of *fore wing* with basal area to vein 2 grey tinged with crimson, costal edge grey, distal area crimson strongly tinged with yellow, markings of upperside faintly showing. *Hind wing* paler than above.

Antennæ grey-brown except basal two-thirds of shaft, which is crimson above; palpi crimson inside and grey-brown on outer side; frons grey-brown; head and thorax crimson irrorated with yellow; abdomen above salmon-pink, basal two segments and anal tuft grey-white; thorax and abdomen below grey-white; legs grey-white marked with crimson, anterior coxæ crimson on inside. Length of fore wing 16 mm.

Hab. French Guiana, St. Laurent, Maroni River, July–Sept. 1915, 2 ♂♂.

Whilst Sir George Hampson regards this as an *Aræomolis*, it may be useful to point out that it differs from his original diagnosis of that genus. The fore wing has vein 10 originating before 7, and the hind wing has 3 and 5 on a short stalk, and 6 and 7 from the cell. The fore wing has a patch of androconia below the cell in the median area. The hind wing has the costa lobed, and bears a small patch of androconia on the upperside above the cell; on the underside of the inner margin is a fold containing a brush of androconial hairs which are club-shaped. The antennæ are serrate and fasciculate.

4. **Automolis ignivena**, sp. n. (Pl. I. fig. 7.)

Near *ditissima* Walk. from S. Brazil, but larger and with a differently shaped apical patch.

♀. Upperside of *fore wing* fuscous-brown irrorated with blackish, darker on the inner margin, basal area paler; apical patch pale yellow, extending to vein 3, outwardly defined by pale orange, which also colours the veins traversing it; the part filling cellule 4 is half the length of the areas in 3 and 5; a discal zigzag crimson line from the costa at vein 6 to the middle of inner margin, outwardly curved to vein 3, then directed basad to submedian, thence distad to margin on the black area, being here much thickened and enclosing a yellow spot; anteriorly the teeth formed in cellules 3–5 are filled in with pale orange; some reddish suffusion at the base; a short crimson basal streak below cell; costa pale orange; veins crimson. *Hind wing* dark brown, also fringes; apex produced and a short anal lobe.

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* *Aræomolis sanguinea* Hampson, A. M. N. H. ser. 7, vol. xv. p. 442 (1905) Cayenne).

Underside of *fore wing* dark brown, apical patch as above; basal two-thirds of cell and a stripe below it pale yellow. *Hind wing* with a pale-yellow subbasal spot below costa.

Antennæ brown, white anteriorly; palpi with first segment white, the rest grey on outside, black on inside; frons grey-white; head pale orange; thorax yellowish white marked with orange, two black dots at base; abdomen crimson above, white below; pectus white; legs white, fore-legs marked with pale orange. Length of fore wing 18 mm.

Hab. North Peru, Charape River, Tabaconas, 4000 feet: A. E. Pratt, 1912. 1 ♀.

5. AUTOMOLIS OCHREOGASTER, sp. n. (Pl. I. fig. 8.)

♀. Upperside silky-white; underside similar with the veins brownish.

Head, tegulæ, patagia, and base of abdomen silky-white; antennæ with shaft white above, brown below, serrate and fasciculate; frons with a tinge of ochreous; an ochreous line at side of eye; abdomen pale ochreous; legs grey-white; palpi white, ochreous on inside.

Hind wing with 3 and 5 stalked, 6 and 7 stalked, 8 from middle of cell.

Length of fore wing 17 mm.

Hab. Sapucay, Paraguay, July 1902, 1 ♀.

Similar to *albescens* Roths., but differs in neuration of hind wing.

6. AUTOMOLIS OCHREOMARGINATA, sp. n. (Pl. I. fig. 9.)

Nearest *sicilia* Druce, from Mexico and Panama.

♂. Upperside.—*Fore wing* orange-yellow, the apex thinly scaled with black. A narrow terminal buff margin widening posteriorly. *Hind wing* paler yellow than fore wing, darker along outer and inner margins.

Underside as above.—*Fore wing* with apex and costal edge narrowly black to within a quarter from base. *Hind wing* deeper yellow on costal area.

Head and thorax orange-yellow; frons metallic blue, anteriorly ochreous; vertex with a metallic-blue spot: palpi black, ochreous on the outside; antennæ black, serrate and fasciculate; legs ochreous striped with black; abdomen black above, first and second segments orange-yellow, segments 4–6 with a metallic-blue dorsal spot, a lateral and sublateral series of metallic-blue spots reaching terminal segment, ventral surface ochreous with narrow black bands. Length of fore wing 16 mm.

Hab. French Guiana, St. Jean du Maroni, 1 ♂.

7. Glaucostola maroniensis, sp. n. (Pl. I. fig. 10.)

♂. Upperside.—*Fore wing* blackish brown, greyish between the veins; two large irregularly-rounded white spots, one subbasal, the other subapical; inner margin at the base narrowly orange. *Hind wing* pale orange with black outer margin, which is widest at angle of the wing and narrows posteriorly.

Underside.—*Fore wing* with basal area white and fovea bearing a tuft of white hair. *Hind wing* as above.

Head orange, a black spot on vertex, frons black; palpi black, paler on outside; antennæ black, serrate and fasciculate; tegulæ orange with mesial black spot; thorax grey-black; abdomen orange, paler below, segments 5 and 6 black dorsally and laterally, a lateral row of black spots; legs grey-black and ochreous. Length of fore wing 13 mm.

Hab. French Guiana, St. Jean du Maroni, 1 ♂.

Differs from typical *Glaucostola* in antennæ being serrate and fasciculate, and in fore wing having vein 3 from before angle of cell. Near *metaxantha* Schs.

8. Melese flavescens, sp. n. (Pl. I. fig. 11.)

This distinct species belongs to Sect. ii. of Hampson's diagnosis, and the antennæ are serrate and fasciculate.

♂. Upperside of *fore wing* fuscous-brown irrorated with yellow. A yellow dot at the base, a yellow spot below the cell on the submedian, another beyond it touching submedian and vein 2, one at the base of cellule 2, a rounded yellow spot beyond the cell in 5. *Hind wing* hyaline, costal and inner margins pale yellow, veins yellowish, fringes yellowish white.

Underside of *fore wing* paler than above, grey-white in the basal area.

Antennæ brown; palpi and lower part of frons pale orange-yellow, upper part of frons fuscous, vertex yellow; tegulæ fuscous, rest of thorax yellow mixed with fuscous; abdomen yellowish brown, fringed at base with yellowish-white hair; pectus and fore-coxæ pale orange-yellow, femora and tibiæ fuscous, tarsi grey-white. Length of fore wing 17 mm.

Hab. Argentine, September, 1 ♂.

9. OPHARUS OCHRACEA, sp. n. (Pl. I. fig. 12.)

This distinct species has no near ally.

♀. *Fore wing* pale ochreous-brown with white markings. A small patch at the base with two black dots; a median band, its upper part directed distad, its lower part below cell narrower and directed basad to inner margin; a broader discal band broken at cellule 2, its upper part formed of an oblong patch at right angles to costa, its lower part below vein 2 narrower and parallel with median band; a narrow postdiscal band of spots, its upper part to vein 4 at right angles to costa and composed of four spots joined together, the fourth much smaller, its lower part curved basad to inner margin and composed of four separate spots smaller than the upper first three; a subterminal series of irregular spots, the first in 7 the second in 6, and nearer the margin, the third and fourth joined in 4 and 5, and below the first, the fifth in 3, the sixth and seventh joined in 2 and 1, the last being curved and close to tornus. *Hind wing* semi-hyaline with a pale ochreous subterminal band, narrowing posteriorly and not reaching inner margin.

Antennæ rufous, basal segment white with a black dot; palpi pale ochreous, black at sides; frons pale ochreous, anteriorly with a black spot; vertex white with a black spot; tegulæ white, bearing two black spots; patagia white with black spots and fringed with ochreous brown; abdomen pale orange above, grey-white below, with a dorsal and lateral series of black spots; pectus grey-white; legs ochreous-brown, fore-coxæ bearing a black spot on inside. Length of fore wing 25-27 mm.

Hab. North Peru, Charape River, Tabaconas, 4000 feet: A. E. Pratt, 1912. 2 ♀♀.

10. NERITOS PURPUREOTINCTA, sp. n. (Pl. I. fig. 13.)

This distinct species belongs to Sect. iii. of Hampson's diagnosis, and the antennæ are serrate and fasciculate.

♂. Upperside of *fore wing* pale purple, with a darker brownish basal area; a crimson dot at extreme base, another at base of cell, another, encircled by black, in upper basal part of cell; a black line strongly curved outwards, from origin of vein 2 to inner margin and bordering a rounded crimson inner spot; beyond it a second curved blackish line below vein 2; some blackish scaling in outer part of cell; a crimson basal streak on inner margin; a broad postdiscal semihyaline band of pale amber-yellow, its inner edge straight and oblique, margined with crimson, the distal edge curved inward, also margined with crimson, cutting off a rounded apical patch; veins traversing apical patch crimson near margin and blackish behind; costal edge crimson except on the band; fringe of outer margin pale yellow. *Hind wing* pale orange-yellow, costa pinkish.

Underside of *fore wing* similar to upperside, basal area darker, paler in the median space; crimson edging to the band better defined; apical area darker, more invaded by crimson. *Hind wing* with costa pale crimson.

Antennæ reddish brown, crimson in basal part; palpi crimson, second segment marked with brown, first segment white in outer and basal part; head and thorax crimson and with a blackish-brown patch; abdomen orange-yellow above with a white basal dorsal spot; pectus and abdomen below white; legs white, fore- and mid-tibiæ and tarsi pale yellow. Length of fore wing 13 mm.

Hab. French Guiana, St. Jean du Maroni, 1 ♂.

20. New Butterflies from Africa and the East. By J. J. JOICEY, F.L.S., F.Z.S., F.E.S., and G. TALBOT, F.E.S.

[Received June 20, 1917. Read November 20, 1917.]

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The types of the forms herein described are in the collection of Joicey.

PAPILIO ILLYRIS HAMATUS, subsp. n.

♂. Upperside with broader bands. *Fore wing* with band straighter on its outer edge. *Hind wing* with a bar at the end of cell, almost cutting off a cell spot.

Underside with reduced red on the hind wing; the red line fringing the black spot in 7 is very narrow, and the black spot is reduced to a straight bar; white spot beyond cell enlarged and entering the cell.

Hab. German East Africa (British occupation), ex coll. Suffert, 1 ♂.

CHARAXES MAUDEI, sp. n.

Allied to *xiphares* Cram. and *cithæron* Feld., and perhaps linking these two species together.

♀. The upperside resembles *cithæron* and the underside more like *xiphares*. Much larger than any females we have seen of these two species.

Upperside of *fore wing* with a broad white discal band, broken where 1 *c*, 2, and 3 cross it, the spot in 3 larger than the others, in 1 *c* smaller than the spot below it; 3 subapical spots as in *cithæron*, followed by 6 spots in 5, 4, 3, 2, 1 *c* and 1 *b*, forming a subterminal series of fulvous spots, the two upper ones being white proximally, the two lower ones placed close to the lower median white patches. *Hind wing* with a broad white discal band formed as in *cithæron*, its distal edge with diffuse purplish scaling; a postdiscal series of 5 fulvous spots in cellules 2–6, the anterior one touching the discal band; a subterminal series of small violet spots; marginal lunules thicker than in the two allied species, the anterior 3 fulvous, the posterior 3 dull green.

Underside with greener ground-colour than in the allied species. *Fore wing* with discal band continuous, its proximal edge indented so that the black line is strongly curved in the lower median space, and in 2 and 3; black post-discocellular line much thicker than in the allied species; subterminal fulvous spots much brighter than in *cithæron*, some faint whitish scaling distally of the upper 5 spots, which is seen completely developed in *xiphares*; black subterminal spots in 2 and below it as in *cithæron*, and not so large as in *xiphares*. *Hind wing* with discal white scaling from costa to vein 4 more developed than in *cithæron*, but much less so than in *xiphares*; other markings as in *cithæron*.

Length of fore wing 57 mm.

Hab. German East Africa (British occupation),—Lindi, 1 ♀, ex coll. Suffert.

CHARAXES SMARAGDALIS ORIENTALIS, subsp. n.

♂. Differs from the type-form in reduced blue on both wings. The patch below vein 2 on the *fore wing* is reduced distally and is indistinctly divided by a curved line between vein 2 and the submedian, a line which sometimes appears in the typical form. The blue band of the *hind wing* does not extend basad beyond the point of origin of veins 3 and 4; it is also reduced distally and the spot in 6 is only about two-thirds the typical size; the submarginal spots have only the faintest trace of a white dot.

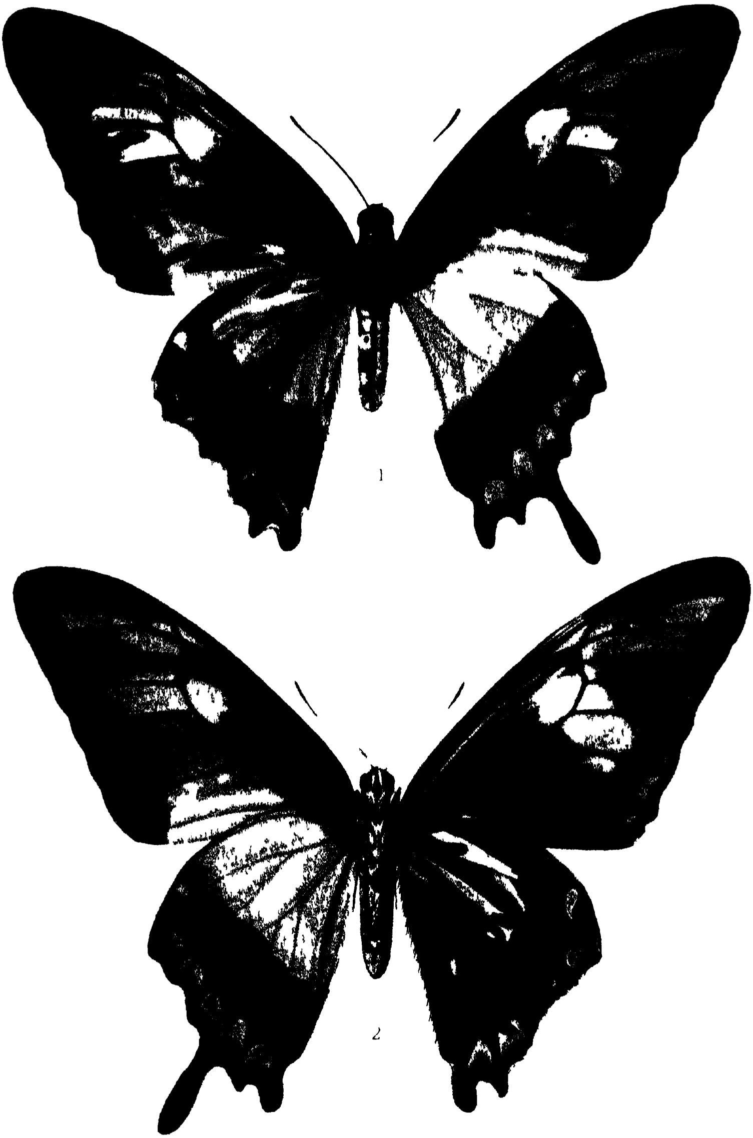
Underside more yellowish, the yellow subterminal lunules thicker and without any white scaling.

Hab. East Africa—Kericho, July 1903 (*Jackson*), 1 ♂. In Tring Museum 1 ♂ from Rau, Nandi, 12. 2. 98 (*Dr. Ansorge*).

PAPILIO POLYDORUS ULAWAENSIS, subsp. or aberr. n.

Near the race *polydæmon* Math. The *hind wing* with discal patches obsolete above and much reduced below.

Hab. Ulawa Island, North Solomons, 1 ♀, ex coll. Grose-Smith.



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GYNANDROMORPH OF PAPILIO LYCOPHRON HBN

21. A Gynandromorph of *Papilio lycophron* Hbn. By J. J. Joicey, F.L.S., F.Z.S., F.E.S., and G. Talbot, F.E.S.

[Received June 20, 1917: Read November 20, 1917.]

(Plate II.*)

This remarkable specimen is a well-marked example of gynandromorphism, the right hind wing above being normal. It belongs to the race *phanias* Roths. & Jord.

Both fore wings are asymmetrical and each shows a large spot in the end of the cell. The *right fore wing* has the band interrupted between the submedian fold and vein 3, two small spots being left below vein 2; the outer part of the spot in cellule 3 remains and the inner portion of it is nebulous, the spot in 4 is indented distally, the spot in 5 is only represented by a streak above vein 5, the spot in 6 is reduced distally, also the spot in 7. The *left fore wing* shows some traces of the band in the median area, and on the inner margin the spot in 4 is reduced as on the other wing, the spot in 5 is slightly reduced anteriorly, that in 6 is represented by a curved proximal line and a distal dot, the one in 7 reduced to a proximal dot. The *right hind wing* is normal except for some orange scaling at the lower angle of the yellow band. The *left hind wing* has the band invaded by streaks of brown ground-colour, and notably a broad stripe filling the lower part of the cell from the base to the end; there is some orange scaling at the lower angle of the band. The distal area is damaged, but there is some green scaling in cellules 3-5; the apical spot is much larger than on the other wing.

The underside of the *right fore wing* is normal. The *left fore wing* is darkened over the inner and median area and lower half of the cell. The *right hind wing* has the red discal spots larger than usual. The *left hind wing* is more strongly darkened than above, leaving a yellow streak in the cell, in 7, and in 6, with other minor traces of the band. The red spots are a little larger than on the other wing, especially the apical spot.

The abdomen bears some scattered dark-brown spots.

This specimen was obtained by Mr. A. E. Pratt at the Rentema Falls on the Upper Amazon, North Peru.

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* For explanation of the Plate see p. 276.

22. Three Aberrations of Lepidoptera. By J. J. JOICEY, F.L.S., F.Z.S., F.E.S., and G. TALBOT, F.E.S.

[Received June 20, 1917; Read November 20, 1917.]

The specimens described herein are in the collection of Joicey.

A Melanic Aberration of CATAGRAMMA CYNOSURA Hew.
(Pl. I. fig. 3.)

Upperside of *fore wing* with distal red band much obscured by dark scaling and showing faintly; apical spot absent. *Hind wing* with red basal patch reduced and limited by vein 6.

Underside of *fore wing* with blue subterminal line thickened and forming a series of 6 proximally pointed spots; subapical yellow streak represented by a thin and shorter line. Yellow discal band narrower and reduced proximally. *Hind wing* much blackened; yellow costal patch reduced, yellow band encircling the disc only represented by a short streak before vein 2, discal transverse streak absent, distal series of blue spots nearer the cell and smaller.

The specimen bears the locality "Peru."

PHILOSAMIA CYNTHIA Drury.
Aberration.

This remarkable aberration is a ♀ specimen bred in Trinidad, B. W. I., and received from there by Mr. Ernest Swinhoe.

The ground-colour of the wings is much darker and in the distal area is nearly black, excepting the grey marginal border. The white bands are very broad. On the *fore wing* the post-discal band is united with the basal bands at vein 4 and the submedian, the space between these being white; the distal widening of the lower basal band leaves only a small patch of ground-colour on the inner margin; similarly the widening of the upper basal band and the proximal widening of the post-discal band reduces the discal lunule to a small ovate spot which is obsolete on the left wing.

The bands of the *hind wing* are united anteriorly so that the space between costa and origin of vein 5 is white; the discal lunule is very small on the left wing and minute on the right wing. The distal normally pink scaling on both wings is replaced by grey.

Abdomen wholly white; head and tegulæ white.

PAPILIO NEOPHILUS PARIANUS R. & J.
Dichromatic Aberration.

This is an example of erythrism in a ♂ specimen which has the patches on the fore wing salmon-pink instead of green; the anterior spot is translucent, and the scales on the underside in the area of this spot are also pink. The scales have suffered no displacement; those forming the anterior spot are longer and narrower than the more ovate ones of the lower patches, and are mostly tridentate, like those of the underside, this being normal.

Hab. Las Quiguas, Esteban Valley, N. Venezuela, Nov.–March.

EXPLANATION OF PLATES I. & II.

Plate I.

Fig. 1. *Vila eueidiformis.*
1*a*. „ „ f. *radiata.*
2. *Polygrapha cyanea* G. & S. ♀.
3. *Catagramma cynosura* Hew. Aberration.
4. *Idalus flavithorax.*
5. *Neonerita metaphœnica.*
6. *Aræomolis nigripuncta.*
7. *Automolis ignivena.*
8. „ *ochreogaster.*
9. „ *ochreomarginata.*
10. *Glaucostola maroniensis.*
11. *Melese flavescens.*
12. *Opharus ochracea.*
13. *Neritos purpureotincta.*

Plate II.

Fig. 1. Gynandromorph of *Papilio lycophron* Hbn. Upperside.
2. „ „ „ „ Underside.

23. Ant-like Spiders from Malaya, collected by the Annandale-Robinson Expedition, 1901–2. By H. D. Badcock, M.A.*

[Received July 7, 1917 : Read October 23, 1917.]

(Text figures 1–12.)

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The Spiders here described were collected by Dr. Nelson Annandale and Mr. H. C. Robinson in the Malay States in the years 1901 2, and are now under the charge of the British Museum, South Kensington.

The specimens examined were :—

THOMISIDÆ.

Strigoplus	1
Amyciæa	1
Epidius	1

SALTICIDÆ.

Myrmarachne	55
Agorius	1

Many of these were accompanied by ants which have been numbered for reference, but which have not been identified.

The species of Thomisidæ and of *Agorius* are known. Of *Myrmarachne*, with the exception of *M. maxillosa*, of which there are 13 specimens, all seem to be new species. Material in the British Museum available for comparison is, however, scanty, and the descriptions and especially the figures dealing with known species are so scattered and often inadequate, that certainty on this point is at present impossible.

Myrmarachne maxillosa female was very common, and it is curious that no male was found. In general shape *M. biseratensis* is very much like it, but it differs in teeth and tibial spines from all previous, descriptions of the male of that species. It may ultimately prove to be a variety.

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* Communicated by the SECRETARY.

M. turriformis is a very distinct species of the Plataleoides group.

M. cornuta is distinguished from all other species here described by the excess of length of the second over the first joint of the pedicel.

The distinction between *M. albiocrurata* and *M. lateralis* is not very satisfactory, and one specimen occurs which suggests that these are only varieties of a single species.

The males *M. ramosa* and *M. gedongensis* are well marked, but there is no information to suggest to which (if any) of the females they belong.

The chief diagnostic differences between the various species of *Myrmarachne* are given in the key preceding the descriptions. The group is a difficult one. In general shape the prosoma falls into three classes, viz., somewhat squat with a narrow and shallow thoracic groove and thorax falling rapidly behind it (*maxillosa*, *biseratensis*), caput towering high above thorax (*turriformis*), and caput and thorax separated by a wide groove of moderate depth with caput not much higher than thorax (all the rest). The prosoma is further characterized by the presence or absence of a wedge of white colour below the thoracic groove, but this is liable to be almost obliterated.

Constriction of the opisthosoma or the absence of it seems a constant character, though its depth and the extent of light coloration about it are variable. The shape of the unguis and armature of the falces in the male are always characteristic.

The shape of the sternum, though in cases appearing very definite, is certainly variable to a considerable extent and except in extreme cases is a doubtful guide. The epigyne appears to differ in the figures, but it is probably more due to differences in condition than specific differences. The male organs all consist of a fine coiled spine of about 1½ turns with slight, if any, specific differences; but distinction may be based on the relative lengths and shapes of the last three palpal joints and the terminal process of the tibia, none of which, however, is particularly striking.

In both sexes the number of spines below the patella and tibia afford marked distinctions and are probably as good a first guide as anything. They are, however, liable to be rubbed off and are not absolutely constant.

In every case the practice adopted has been to start with a detailed description. This has been followed in the case of *Myrmarachne* by a short description or diagnosis. Finally a note is given stating the place where and circumstances under which specimens were taken, any particulars concerning them and any measurements made. In the case of these last it must be remembered that the specimens, having been in spirit for years, were very brittle and difficult to measure with accuracy, and that the figures given must only therefore be taken as approximate.

In the following descriptions I have used Lankester's terms "prosoma" and "opisthosoma" for the main divisions of the body, while retaining "caput" and "thorax," employed by Cambridge, as convenient terms for the two parts of the former.

The "thoracic groove" is the depression between caput and thorax. "Cephalic wedge" the wedge of white hairs or colour at the side of the prosoma reaching downwards from the groove. "Width" or "height" means greatest width or height.

The eyes are referred to as 1, 2, 3, 4 in the order—central of front row, lateral of ditto, central of back row, lateral of ditto; the small eye of the Salticidæ being considered as 3 in this series.

The intervals between the eyes are expressed as 1 . 1, 1 . 2, &c. When the shape of a quadrilateral of eyes is mentioned it is considered as the quadrilateral circumscribing the eyes in question. The letters f, b, o, u referring to an eye indicate that it is directed forward, backward, outward, upward.

The basal end of the groove of the falx is the end nearest the root of the unguis.

The joints of the legs are referred to as c, tr, f, p, ti, m, and ta, with a subscript letter to denote the particular leg where necessary; thus tr_3 means "trochanter of third leg." j_1, j_2 refer to joints of pedicel.

In describing the prosoma the order adopted has invariably been: (*a*) as seen from above, (*b*) from the side, (*c*) from in front. In the case of the falces and opisthosoma it has been (*a*) from above, (*b*) from the side, (*c*) from below, though in none of these has it always been thought necessary to describe from all these positions.

The upper margin of the groove in the falces is always that furthest from the maxillæ, even though this in the case of *Amyciæa* and some female Salticids may more correctly be described as "outer."

Key to Myrmarachne *mentioned in this paper.*

1.	*a*.	Second joint of pedicel much greater than first. Opisthosoma constricted	*cornuta*.
	b.	Second joint of pedicel equal to or more often much less than first	2
2.	*a*.	Opisthosoma not constricted	3
	b.	Opisthosoma constricted	5
3.	*a*.	Pedicel short	4
	b.	Pedicel long	*turriformis*.
4.	*a*.	Spines on 1st tibia 6 to 7 pairs	*maxillosa* ♀.
	b.	Spines on 1st tibia 5 pairs	*biseratensis* ♂.
5.	*a*.	1st patella no spines, 1st tibia 4 pairs	*albicrurata* ♀.
	b.	1st patella 1 spine	6
	c.	1st patella 1 pair of spines, 1st tibia 6 to 7 pairs	7
6.	*a*.	1st tibia 4 spine pairs	*ramosa* ♂.
	b.	1st tibia 5 to 6 pairs	*lateralis* ♀.
7.	*a*.	White wedge on side of prosoma	*cuneata* ♀.
	b.	No white wedge	*gedongensis* ♂.

THOMISIDÆ.

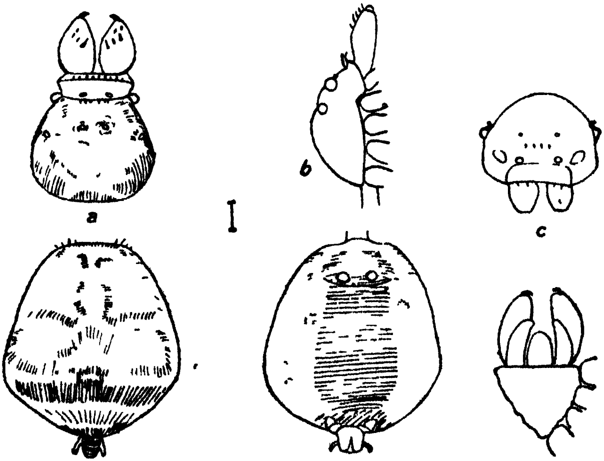
STRIGOPLUS E. Simon, 1885.

♀. STRIGOPLUS ALBOSTRIATUS E. Sim. (Text-fig. 1.)

S. albostriatus E. Sim. Bull. Soç. Zool. de France, 1885, p. 144.
Peltorhynchus rostratus Thorell, K. Sv. Vet.-Akad. Handl. xxiv. p. 2 (1891).

PROSOMA.—(*a*) Clypeus nearly straight or very slightly recurved, with fringe of stiff red hairs projecting forward slightly; notch on sides behind clypeus then swells out to $\frac{4}{3}$ and then inwards, ending in a truncation slightly narrower than width of clypeus. Thorax and caput cannot be separated except by colour. Clypeus and a triangle from outside eyes 4 to centre of cephalothorax is light yellow (caput), remainder darker yellow-brown (thorax). Caput has a still lighter fine line proceeding forward from apex of triangle and stopping just beyond line of 3 . 3 at a transverse line of stiff hairs similar to those on clypeus. This line is slightly expanded into a dot immediately after its start. A similar light line crosses this at right angles between 4 . 4, the two lines together forming a faint but distinct cross. Eyes 2 and 4 are on tubercles with a distinct blue tinge which is striking. Line centre to eye 4 is marked by two light dots similar to that on central line, and these dots form approximately the line of demarcation between the light and dark portions (caput and

Text-figure 1.



Strigoplus albostriatus E. Sim., ♀.

a. Prosoma from above. *b.* Do. profile. *c.* Do. from in front. *d.* Sternum &c. *e.* Opisthosoma from above. *f.* Do. from below.

thorax) of prosoma. There are also less distinct dots or streaks radiating from centre and marking other thoracic divisions. Dark portion is bordered by a thin white marking at hind corners, and there is a very thin darkening at outer edge. Cephalothorax is practically free from hairs except the bristle fringes and a very slight thin pubescence at edges.

(*b*) Clypeus slopes very gradually backwards and upwards with convex section, and on this view is equal in length to eye-cliff, its rise being very slight. Portion of face containing eyes 2 now rises vertically or rather slightly overhanging, and from here to centre of cephalothorax (which is well behind eyes 4) top is flat with slight rise; thence 45° slope to rear. White marking is prominent at rear end and can be traced round to front as a fine white line. Eyes 2 and 4 are also prominent on side view.

(*c*) Clypeus slightly procurved and about = eye 1; top convex, sides straight.

Cephalothorax has somewhat the appearance of a death's head.

Eyes.—1st row distinctly procurved.

1 . 1 nearly $=2 \times 1 . 2$, on slight tubercles of bluish tinge, o. u. f.

$2=2 \times 1$, largest of the 4, on blue tubercle connected by valley with tubercle of 4, the whole markedly blue, o. u. f.

$3=\frac{1}{2} \times 1$, smallest of all, u.

4 very slightly <2, blue most marked and tubercle most prominent, o. b. u.

$2 . 3$ very slightly $<1 . 1$; $3 . 3=4 . 4$ approximately.

Total length of 2nd row greater than 1st. Trapezium 1 . 3 . 3 . 1 is narrower behind than before and approximately as wide as long.

Falces nearly horizontal, projecting forward and very prominent from above, broad at base and rounded, rapidly reducing to apex and curving slightly apart on inner side so that there is a distinct space between. Short tooth-like spines from about $\frac{1}{3}$ to apex, one on top near commencement being distinctly stronger than the rest. Lower side free from hairs. Groove indistinct and toothless. Outer margin has a thin scopula of moderate hairs.

Maxillæ. Long, nearly = falces, broadest at base, slightly concave without and within round labium and tapering to a blunt point, greatest slope being on outer edge. Short spines all over lower side. Serrula on outer edge after concavity. Scopula strongest at angle but also slight on inner side.

Labium shaped like a Florence flask, length = maxilla = 3 breadth; blunt-pointed.

Palpi.—One missing, other broken after patella. Light-coloured, stout, cylindrical.

Legs.—Mostly detached and damaged.

1st. One missing, other broken after femur. Light especially on top of f, which is marked with somewhat indistinct longitudinal series of white spots.

2nd. Two detached legs are probably 2nd. These have:—

f dark with distinct large white spot at centre and one at apical end on each side, and a fainter one at basal end on one (? both) sides. p dark.

ti = f = 3 p, a little lighter and with white annulation about centre; basal ⅓ darker and < apical.

m < ti, dark at base, then a white spot followed by light end.

ta light, < m, and distinctly lighter for basal half.

Claws 2, pectinated with about 5 teeth.

3rd. Only one remains. Much lighter, no distinct markings. Slight hairs thickest on m & ta.

4th. Both missing.

There are three detached legs resembling 3 and three resembling 2; presumably, therefore, 3 and 4 are much alike and 2 and 1, though the detached one is not much like the attached 1. In any case none has any spines, though all have considerable hairs on ti, m, ta. All joints are cylindrical except f_1 and f_2, which are slightly bow-shaped though not angular.

Sternum.—Broad, nearly an equilateral triangle, with fore side straight, sides slightly convex, and hind end a blunt point.

OPISTHOSOMA.—Light and dark brown.

In front a slightly recurved narrow transverse white line with short central white line projecting back and rather indistinct returns at ends.

About middle a white line, whole width of abdomen, waved doubly at centre.

About same interval another straight line broken on each side of centre.

4th line wavy and shorter.

5th shortest, just above spinners.

The darker brown is more or less bounded in front by the white line, light after 3rd.

Shape an amphora with spinners for neck. Sides have some more or less irregular white splashes or spots which bound lower surface; a pair on each side of lung-sacs and a shortest pair at base of spinners are very marked.

Below, brown. Lung-sacs small, light, fairly wide. Epigastric fold marked, procurved.

Spinners.—1st barrel-shaped; 3rd longest and thinner; all hunched.

Note.—Description from a single ♀ somewhat damaged, from Sungkei, found in company with ant no. 2. The prosoma and opisthosoma were separated and the legs were not measurable.

Prosoma 1·2 long × 1·2 wide × 1·1 mm. high.

Opisthosoma 2·0 × 1·8 × 1·4 mm.

The prosoma is widest and highest at ⅔, the opisthosoma widest at ⅓, highest at ½.

Total length estimated at 3 mm.

AMYCIÆA E. Sim., 1885.

♀. AMYCIÆA FORTICEPS O. P. Cambridge, 1873. (Text-fig. 2.)

Amycla forticeps O. P. Cambr. P. Z. S. 1873, p. 122.
Amyciæa forticeps Thorell, Spid. Burm. p. 282.

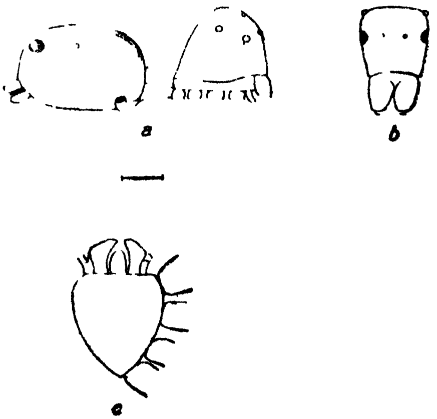
PROSOMA. –(*a*) From above truncated but slightly recurved in front, the same but slightly procurved behind, sides slightly convex, widest a little behind centre.

(*b*) Nearly as high as long, very convex, very steep in front to eye 2, then slightly and convexly rising to highest point over eye 4, then with a more gradual and very slightly convex slope to hind end.

(*c*) In front sides convex, subparallel, front edge slightly procurved. Clypeus = eye space.

Colour reddish yellow, with a few black hairs on front edge and between eyes. Very faint traces of fovea immediately behind eyes and striæ therefrom.

Text figure 2.



Amyciæa forticeps O. P. Camb., ♀.
a. Profile. *b*. Prosoma from in front. *c*. Sternum &c.

Eyes.--First row straight and subequally spaced, 1 . 1 being possibly very slightly < 1 . 2. 2 large on bluish tubercle = 4 × 1. 2nd row strongly recurved so that 3 . 3 is well in front of 4 . 4.

Quadrilateral 1 . 3 . 3 . 1 is very much wider behind than before. 3 considerably < 1.

Quadrilateral 2 . 2 . 4 . 4 slightly wider than long, a rectangle. 4 large on blue tubercles but slightly < 2.

Falces not longer than clypeus, slightly stouter at base than apex, which is cut square. On side view rather more tapering. Unguis small. A weak scopula below unguis, and inner sides of falces with short, dark, stiff hairs in a regular row, longest at unguis.

Maxillæ.—Narrow at base, at first parallel then curving inwards to rounded points facing each other in front of labium. On inside curves closely round labium. Serrula from well on outer side round end to point, very weak. Scopula very weak just inside point.

Labium.—Length = $\frac{2}{3}$ maxilla. Breadth $< \frac{1}{2}$ length. Sides slightly constricted immediately after base and then convex to a round point.

Palpi.—Spring from base of maxilla. All joints cylindrical. f much longest, $> c_1$; p, ti, ta increasing in length, but all short; ta has a single simple claw.

Legs.—2 . 1 . 4 . 3, with 2 and 1 practically equal and marked differences between the others. All are cylindrical except coxæ, which are rather rectangular on section. Proportions of joints much the same in all, f, ti, m, ta being in decreasing order with m about $\frac{1}{2}$ ti or 2 ta. Femurs of 1, 2, and 4 have a weak short spine above near apex, otherwise there are no spines. Tarsi have two claws, pectinated, with more teeth on one than the other; teeth close together and extending throughout.

Sternum.—Shield-shaped, cut straight and broad in front, and with a short point behind. Nearly as broad as long. $c_{1.1}$ whole width of sternum, $c_{4.4}$ close but not in contact.

The colour of the prosoma including appendages is a dull orange-yellow.

PEDICEL.—Moderate, distinctly visible from above, slightly tapering forward, single-jointed, covered at top with a long narrow lorum. Nearly white.

OPISTHOSOMA.—Length nearly = 2 width or height. Somewhat flask-shaped from above, distinctly widest at $\frac{2}{3}$. Light grey or mouse-colour, with two longitudinal sets of white spots, rather irregular in disposition, proceding from front to widest place and spreading outward. These terminate each in a large black spot.

Below plain. Lung-sacs very dark and wide apart. Epigastric fold distinct.

Epigyne.—Rosette-shaped. Not noticeable.

Spinners.—All short; 1st and 3rd pair making a rectangle considerably broader than long; 2nd pair between 3rd, so that 3 . 2 . 2 . 3 is a straight line. All spring from sockets in a common projection, all 2nd joints very small.

1st stout barrel-shaped. 2nd shortest, cylindrical, thinnest. 3rd cylindrical, intermediate.

Anus.—Tubercle rather broad and thin, nearly as high as 3rd spinners.

Note.—Description is from a single ♀ dropped from a tree in the jungle at Biserat.

The following are the measurements:—

Prosoma .... 2·0 × 1·5 wide × 1·6 mm. high.
Opisthosoma .... 2·7 × 1·8 „ × 1·9 „
Palpus .... 1·4.

Legs.—1	c+tr 0·6,	f 2·2,	p+ti 2·2,	m+ta 2·2	=7·2
2	„ 0·6,	„ 2·2,	„ 2·2,	„ 2·3	=7·3
3	„ <0·6,	„ 1·5,		p+tr+m+ta 2·4	=4·5
4	„ <0·6,	„ 1·1,		„ 3·7	=5·4

Ant accompanying, none.

EPIDIUS Thorell.

♂. EPIDIUS LONGIPALPIS Thor. (Text-fig. 3.)

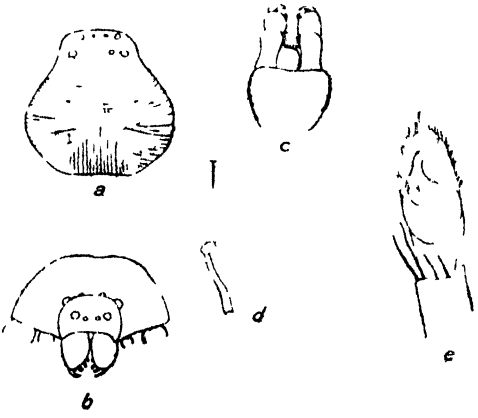
E. longipalpis Thor. St. Rag. Mal. i. 1877, p. 152.

PROSOMA.—(*a*) Caput truncated or very slightly convex in front, swells out slightly and concavely at sides to thorax, which is much wider and rounded at sides and slightly concave at rear. Caput is cut off above by strong striæ, and there is a deep fovea and thoracic striæ. Caput has a central longitudinal indentation from fovea to 2nd line of eyes. Colour dirty brown, lighter at indentations and rear of thorax.

(*b*) Clypeus vertical, gradual slope up from 1st eyes to mid thorax, then more abrupt slope to end.

(*c*) Clypeus nearly = face, very slightly procurved. Caput convex above and at sides, thorax convex at sides and flattened above.

Text-figure 3.



Epidius longipalpis Thor., ♂.

a. Prosoma from above. *b.* Do. from in front. *c.* Sternum &c. *d.* Tarsus. *e.* Palpus.

Eyes.—1st row recurved, 1 . 1 = 1 . 2, 1 = $\frac{1}{3}$ 2. 2nd row recurved as viewed from above but less so than 1st row, slightly procurved as viewed from in front, considerably longer than 1st. 3 . 3 very slightly > 3 . 4, 4 very slightly > 3.

Trapezium 1 . 3 . 3 . 1 longer than broad and nearly twice as broad behind as before.

Falces.—Vertical or very slightly sloped forwards, parallel sides with very oblique long truncation, groove distinct. Upper margin, one small tooth at angle with one smaller above it, and one or more very small below. Lower margin, one tooth half way to angle and two at angle, one of which is fairly large; these two may, however, be really one with two cusps. A strong and long scopula of light hairs on outer margin.

Maxilla.—Moderate, length = $1\frac{1}{2}$ breadth, subparallel, being slightly wider in front than at base. Outer apex rounded, inner obliquely truncated with scopula. Serrula from well before outer rounding to truncation.

Labium.—Length $> \frac{1}{2}$ maxilla, broader than long, strongly barrel-shape.

Palpi.—Remarkably long = about $\frac{2}{3}$ leg 4. Tr simple, much broader than long, breadth = nearly least width maxilla; f length = prosoma, cylindrical, slightly S curved; p very short, $< \frac{1}{6}$ ti; p+ti>f, ti<f and slighter, S curved; four stout bristles at lower apex pointing directly forward and reaching beyond base of fovea; a short sharp apophysis pointing directly forward at lower outer apex. Ta a little >p, very short, subelliptic, with blunt point and fovea occupying about half of it. Organs have largish but flat bulb ending in blunt-pointed extension forward. Style springs from centre and points forward over extension of bulb, ending in a sharp black spine-like point.

Legs.—Only 1st and 3rd on one side remain, 1st being much stronger and about twice as long as 2nd.

1st. c length = nearly 2 breadth.
tr, a few short dark hairs at ridge, fore section distinctly < aft.
f, 2 or 3 spines at top in longitudinal row, a very few smaller at side.
p = $\frac{1}{6}$ ti, hairless.
ti slightly curved, slenderer than f; 3 or 4 spine pairs and a few spines along upper sides.
m nearly = ti, two spine pairs below but stronger and a few at sides.
ta = $\frac{1}{3}$ m, hairless, 2 claws with 5 teeth and fasciculus.
3rd. General proportions as 1st, but much shorter and f stronger. Spines on back of f and p, others as 1st.

Sternum.—Cordiform, as broad as long, very smooth, front corners rounded, rear point rounded. $c_{1.1}$ = full width of sternum. $c_{4.4}$ = width of c_4.

PEDICEL.—Short and stout, with a darker narrow lorum above.

OPISTHOSOMA.—Very much damaged, but appears to be almond-shaped from above, with two or more pairs of spots in a longitudinal series at the fore part above. On a side view very high in front, rising vertically or with a slight overhang from pedicel and falling with a straight slope to spinners.

Spinners compact, short. 1st stout at base, tapering, 2-jointed. 2nd slender, longer, cylindrical. 3rd in shape and proportions between 1st and 2nd.

Anal tubercle.—Wide and noticeable.

Note.—Description is from a much damaged ♂ specimen from Biserat, Jalor, in company with the Salticid spider *Myrmarachne biseratensis* ♂ ♀ and three ants of species 2 and 17.

The following measurements were taken :—

Prosoma .... 1·7 long × 1·7 mm. wide.
Opisthosoma ...... 2·0 or longer, damaged.
Palpi ...... f 1·8, p very short, p+ti 2·0 = abt. 4·0.
Legs.—1 ...... c+tr+f 3·6, p+ti 3·9, m+ta 4·0 = 11·5
3 ... „ 2·0, „ 2·0, „ 1·9 = 5·9

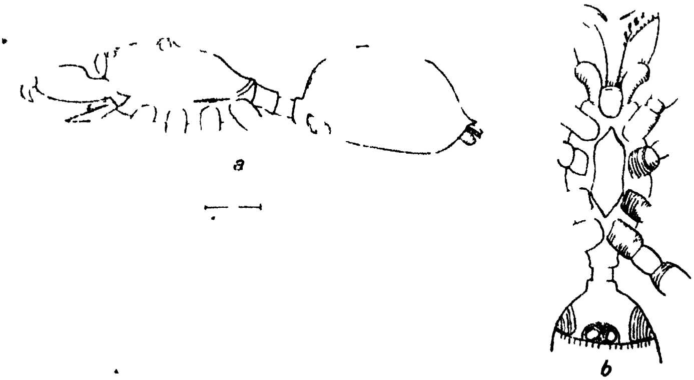
SALTICIDÆ.

MYRMARACHNE Macleay, 1839.

♀. MYRMARACHNE MAXILLOSA C. L. Koch. (Text-fig. 4.)

Toxeus maxillosus C. L. Koch, Die Ar. xiii. p. 19, tab. ccccl xxvi. fig. 1090.
Synemosina procera Thor. Ann. Mus. Genov. x. p. 538 (1877).
Toxeus procerus id. ibid. xxv. p. 346 (1887), xxxi. p. 220 (1892).
Salticus modestus id. Ann. Mag. Nat. Hist. ser. 6, ix. p. 235 (1892), ♀ jun.
Toxeus maxillosus id. Spid. Burm. 1895, ♀.

Text-figure 4.



Myrmarachne maxillosa C. L. Koch, ♀.
a. Profile. *b*. From below.

PROSOMA. Length = patella + tibia of 4th leg, slightly longer than opisthosoma. Greatest breadth and greatest height each nearly ½ length. Caput = or very slightly < thorax. Front wall straight or very slightly recurved and stepped back at eye 2. Side walls straight or very slightly convex. Back wall somewhat procurved as it slopes down to the groove, where the cephalothorax is narrowed above but not at base. Thorax swells out again behind groove towards width of caput, being strongly rounded, and terminates in a truncated or even slightly hollowed end of about half greatest width of thorax.

Clypeus very low, top of caput flat and sloping very slightly upward to eye 4, over which it is convex. Groove is very shallow, hardly reaching as low as bottom of eye 4. Thorax rises very slightly behind it, and then falls with an even but slightly convex slope to rear end, where it rises concavely into a rim which can be traced along sides to caput.

Colour dark mahogany, with black eye-frame broken in front of eye 4 and terminating just below the level of eyes 2 and 4. Scanty short grey hairs all over (Text-fig. 4, *a*.)

Eyes.—1st row straight by summits. 1 . 1 in contact, 1 . 2 close but not in contact. 2 = $\frac{1}{3}$ 1 and slightly behind it. 4 = or very slightly > 2 . 3 < $\frac{1}{4}$ 2, very slightly nearer 2 than 4 and on the upper tangent to 2 and 4. Eye square slightly broader than long, with eyes 4 projecting prominently at hind corners and 4 . 4 very slightly > 2 . 2 and > distance between itself and rim of cephalothorax.

Falces.—Very nearly as long as caput. Length > 2 breadth. Project horizontally forward. Sides subparallel, with inner edge straight to about $\frac{2}{3}$ and then rounded off to base of margins, outer edge very slightly convex. On side view straight at lower edge, upper edge strongly convex making falx very much thicker at $\frac{1}{3}$ to $\frac{1}{2}$ than elsewhere. Unguis = $\frac{1}{2}$ falx, sickle-shaped with base much thicker than tip and curve with a tendency to being straight in the middle with angle inside near base. Groove is marked. Upper margin has typically 8 teeth, of which the first three are close together at base of unguis, increasing rapidly in size from 1 very small to 3 large, 4-6 are large teeth, 7, 8 rapidly decreasing till 8 is very small. 4-8 evenly spaced. 1 and 2 and 8 are sometimes missing. Lower margin has 8 to 10 or more very small teeth close together and reaching from base of unguis to a little beyond angle, but always terminating before the upper ones. They or at any rate the middle ones are alternately large and small. There is a strongish scopula of long grey hairs on upper margin, largest at angle, and of short dark scanty hairs on lower margin.

Colour dark mahogany as cephalothorax. The falces are glabrous and somewhat rough.

Maxillæ.—Length = coxa + troch. of 1st = falx nearly. Outer edges parallel from base to apex of labium, then still remain straight but incline slightly outwards. Outer corner is well rounded and end square, a serrula following the edge from about middle of outer side to end of straight portion. Inner corner very slightly rounded and truncation straight and nearly parallel axis runs back more than half way to labium. Hence slopes slightly outwards and follows labium back to base, being hollowed out to enclose it. Truncation has a strong scopula of black hairs which is extended towards labium and also outwards to inner angle at termination of serrula, where hairs are grey and as long as width of maxilla.

Width at end = labium. Colour light mahogany except for outer edge, which is as dark as cephalothorax.

Labium.—In length $\frac{2}{3}$ maxilla, terminating half way up it. Breadth $\frac{1}{3}$ length. Tapers very slightly from base to apex, which is square. Sides straight. Apex has a scopula of dark hairs. Colour as dark as outer portion of maxilla except for apex, which is light.

Palpi.—Spring from near base of maxilla. Trochanter length = width maxilla. Dark brown except for light yellow on inner basal side. Femur > half length of caput, flattened, narrow at both ends where its width > $\frac{1}{3}$ length. Patella < $\frac{1}{3}$ femur, wedge-shaped, broadening at apex from narrow base. Tibia broadens from base to apex, where it is twice width of patella apex. Tarsus slightly longer than patella, with rounded point. Tibia and tarsus together form a lanceolate plate, glabrous below, nearly twice femur in length, with strong fringes of hairs on both sides and round point. All joints except patella have short grey hairs on back. General colour dark brown green, except as mentioned for trochanter. Total length of palpus where extended = 2 falx, the basal end of tibia being about level with apex of falx.

Legs.—Order 4 . 1 . 3 . 2, with 4 and 1 practically equal and likewise 3 and 2. In the 1st leg patella + tibia and in the 4th metatarsus + tarsus are notably long compared with the other legs.

1st. Coxa length = $2\frac{1}{2}$ breadth, very slightly tapering, light yellow except for brown patch at lower outer vertex.

Trochanter = $\frac{1}{4}$ coxa, narrower, light yellow except for continuation of coxal brown patch strengthened.

Femur strongly clubbed at base, < patella + tibia > tibia, dark except below at apical end.

Patella > $\frac{1}{3}$ tibia, slightly curved downwards. No spines. Dark at sides, light above and below.

Tibia. Has normally 7 spines on the inner and 6 on the outer side below, but there are frequently 6 pairs. The spines are evenly spaced from base to apex, but the largest are in the middle and they get rapidly shorter, so that the apices of the last 3 or 4 are all about level near the end of the joint. Dark at sides, light above and below.

Metatarsus > patella, with two pairs of strong spines longer and stronger than those of tibia, the last of which reach to beyond the middle of tarsus. Dark.

Tarsus < $\frac{1}{2}$ metatarsus, with claw-tuft and 2 claws.

2nd. c equally broad and long, swollen near base, < $\frac{1}{2}$ c_1. Dark brown with a touch of light at apex.

tr short = $\frac{1}{3}$ c, cylindrical, brown with light patch below.

f slightly clubbed at base, brown with light below at apex.

p = $\frac{1}{5}$ ti, curved downwards, no spines. Light above and below, dark sides.
ti. 3 pairs of feeble spines evenly spaced, with a 4th pair extremely short and feeble at extreme apex often missing. Light above and below, dark sides.
m > $\frac{1}{2}$ ti. 2 spine pairs stronger than on ti_2 but much weaker than on m_1, basal is largest, apical only just reaches ta. Light above and below, dark at sides.
ta < $\frac{1}{2}$ m. Light.

3rd. c a little larger and more cylindrical than 2nd c, brown.
tr short, cylindrical, brown.
f brown, slightly clubbed at base.
p short, curved downward, brown except for light patch above at basal end.
ti brown except at tip where light above.
m nearly = ti, light above and below, brown sides.
ta > $\frac{1}{3}$ m, light.

4th. $c > c_1$ but not more than $\frac{2}{3}$ c_1, cylindrical, brown.
tr larger and a little slenderer than c, cylindrical, light.
f long and slightly clubbed at base, brown.
p as p_3.
ti brown throughout, slender.
m very long, nearly = ti, slender, brown except for very small lighter patch at upper apical end.
ta = $\frac{1}{4}$ m, light above and below, dark at sides.

In general appearance the posterior legs are much darker than the anterior, and the light (almost white) 1st c and tr and 4th tr are very noticeable.

Sternum.—Lanceolate, short-pointed between $c_{1.1}$, which are $\frac{1}{4}$ their width apart. Widest from $c_{1.2}$ to $c_{2.3}$, thence tapering to a long point in front of $c_{1.4}$, which are in contact. Sides undulate to accommodate coxæ but do not run into points between them. Broad for the genus, being > width of middle coxæ. Gaps $c_{1.2}$ and $c_{2.3}$ about equal and not materially greater than $c_{3.4}$. Colour mahogany, lighter than coxæ 2, 3, 4. (Text-fig. 4, *b*.)

PEDICEL.—Short but visible from above. First joint covered by brown plate overlapping second. Second joint longer and covered by longitudinal narrow plate. Whole length of pedicel not greater than its w dth. It is received into a short projecting socket in abdomen.

OPISTHOSOMA.—Egg-shaped from above, widest about $\frac{2}{3}$ back. From side overhangs in front and about same level for first $\frac{2}{3}$. Above, general colour a dark green-brown. Below, general colour the same but coarser, and at sides distinctly composed of darker lines separated by light spaces. Lung-sacs very wide apart and dark red-brown, space between around epigyne lighter red-brown. A smoother and darker longitudinal band from epigastric fold to spinners, slightly wider at spinners.

Epigastric fold procurved.

Epigyne. A pair of white oval spots with a darkish mahogany bridge between expanded at both ends. The whole on a ground of the same colour. (Text-fig. 4, *b*.)

Spinners.—1st stout, subconical, light green-brown. 2nd very thin, white, slightly longer than 1st. 3rd a little stouter and darker than 2nd, much thinner than 1st, slightly longer than 1st. All have 2nd joint very much longer than 1st.

Anus on a tubercle of two joints.

SHORT DESCRIPTION.

♀. Prosoma = opisthosoma. Caput = thorax. Groove very slight, with thorax not rising appreciably behind.

Falces project horizontally forward, nearly as long as caput, giving the appearance of ♂. Teeth, upper 8 strong at centre, subevenly spaced; lower 8 small, alternate sized, close.

Legs 4 . 1 . 3 . 2, with 4 and 1, 3 and 2 nearly equal pairs. c_1 and tr_1 and tr_1 are very prominently white. Ti_1 has 6 spine pairs or more often 6 and 7 spines, m_1 2 pairs., p_1 none, p_2 none, ti_2 3 pairs, occasionally a 4th, m_2 2 pairs stronger than on ti_1.

Sternum rather broad. Gap $c_{2\ 3}$ not > others.

Pedicel short but visible from above.

Opisthosoma squat, much thicker than usual in the genus.

Note. Description based on 13 ♀ from Biserat, K. Mahek, c. Patani. It was found practically everywhere and is much the commonest.

♀. The ♂ is possibly *M. biseratensis.*

Length varied from 3·5 (imm) to 7·0 mm., the normal length being 5 to 7.

The accompanying ants were numbers 1 and 2.

Legs of a specimen, ♀ :—

1......	c+ti 1·2,	f 2·5,	p+ti 2·9,	m+ta 1·6	=8·2
2......		c f 2·0,	p ta 2·9		=4·9
3......		c f 2·0,	p ta 3·2		=5·2
4. ...	c+ti 1·4,	f 2·7,	p+ti 2·9,	m+ta 2·3	=9·3

Legs of another specimen, length 6·0, ♀ :—

1 ....,	c–f 3·6,	p+ti 3·2,	m+ta 1·4	=8·2
2	„ 2·2,	p ta 2·8		=5·0
3	„ 2·2,	„ 3·3		=5·5
4	„ 3·6,	p+ti 2·7,	m+ta 2·6	=8·9

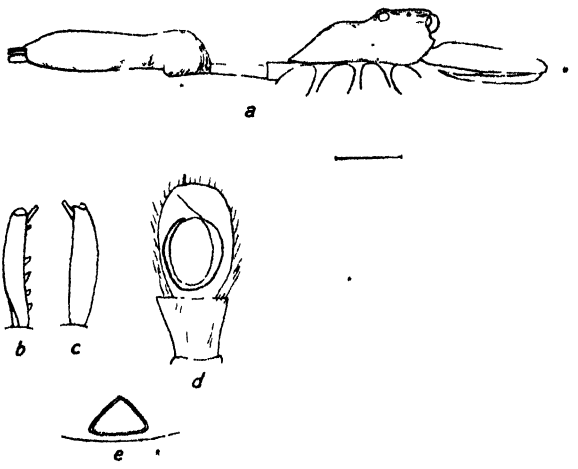
MYRMARACHNE CORNUTA, sp. n. (Text-fig. 5.)

♀. PROSOMA.—(*a*) Length = opisthosoma. Greatest breadth very slightly > greatest height and each nearly ½ length. Caput = thorax. Front wall straight, slightly stepped back to eyes 2. Side walls slightly convex. Rear wall procurved where it slopes back to groove where p.s. is narrowed above but not at base, though white wedge makes it look as if strongly constricted. Thorax swells out again behind groove to width of caput and then narrows with straight or almost concave edges to base, which is cut nearly straight and about $\frac{1}{3}$ greatest width of thorax.

(*b*) Clypeus very low. Caput slightly convex. Groove shallow and broad. Thorax rises behind it to nearly height of caput and then falls with convex and concave slopes to rim, which is slight but can be traced round to caput.

Colour mahogany moderate to dark, with black eye-frame broken in front of eye 4 and terminating just below the line of eyes 2 and 4. In dark species this frame is hard to distinguish. Thorax a shade lighter than caput. Between the two on each side a wedge of white hairs broadest below.

Text-figure 5.



Myrmarachne cornuta, sp. n.

a. ♂: Profile. *b.* ♂: Right falx from below, unguis omitted; *c.* Do. from above. *d.* ♂: Right palpus from below. *e.* ♀: Epigyne.

Eyes.—1st row procurved by summits. 1 . 1 subcontact, 1 . 2 > 1 . 1 but very close. 2 > $\frac{1}{3}$ 1 and slightly behind it. 4 = 2. 3 < $\frac{1}{4}$ 2 and very slightly nearer 2 than 4 and on the upper tangent to 2 . 4. Eye square broader than long and 4 . 4 distinctly > 2 . 2 and much > 4-rim. Eye 4 projects over edge of prosoma but not at all prominently so, and the prosoma is not convex over it in either view.

Falces.—Length < $\frac{1}{2}$ caput = $1\frac{1}{2}$ breadth, nearly vertical with slight forward slope. Outer edge convex, inner more markedly sloping inwards from about $\frac{3}{4}$ to root of unguis. On side view strongly convex above, with almost an angle at $\frac{1}{3}$ so that basal portion is horizontal and apical nearly vertical; straight or very slightly convex below. Unguis regular curve and regular diminution in thickness from base to apex. Teeth on upper margin 5 or 6, of which 3 above angle evenly spaced and of moderate size, others below angle and smaller. Lower teeth 7 or 8, close, about same size from end to end, but alternate ones possibly smaller. Long thickish light scopula largest at angle on outer margin. A few long dark hairs along lower margin.

Colour mahogany lighter than cephalothorax. Unguis at base darker, at apex lighter than paturon.

Maxillæ.—Length $> c_1$, nearly = falx. Narrow at base, outer side curving strongly and concavely outwards beyond labium to bold rounded corner, truncation shortish and at about 45° with axis of body. Inner side slopes outwards from truncation, being strongly hollowed in front of and at side of labium. Dark serrula from outer corner to angle. Light scopula along truncation. Width at base $= \frac{1}{3}$ labium, at end > labium.

Colour mahogany, markedly lighter at inner end.

Labium.—Length $> \frac{1}{2}$ maxilla. Breadth at base $> \frac{1}{2}$ length. Sides parallel at base, slightly inclined towards each other at apex, which is cut off square and has thin scopula of dark hairs. Colour darker than darkest part of maxilla except at apex where light.

Palpi.—Spring from close to base of maxilla. Trochanter < width of maxilla. Femur $= \frac{1}{3}$ caput, flattened, reduced at ends, greatest width $= \frac{1}{3}$ length. Remainder as *M. maxillosa.*

Colour = caput with end joints darkest.

Legs.—Impossible to measure lengths.

1st. Proportions as *maxillosa* except patella $= \frac{1}{2}$ tibia. Patella has 1 spine below towards outer side. Tibia 4 spine pairs, subequally spaced and nearly of equal size but with basal slightly the greater. Apex of last spine just reaches end of joint. Metatarsus 2 spine pairs, basal strongest and somewhat stronger than tibial, apex slightly beyond end of joint.

Colour very light throughout except small dark splash on outer side of trochanter and larger dark splash towards outer basal end of femur and slight darkening on outer side of metatarsus. In a light specimen all these dark markings are absent or merely shades.

2nd. c nearly as broad as long, markedly swollen on inner side about centre.
tr $= \frac{1}{3}$ c, barrel-shaped.
f slightly thicker at base than apex, > ti < p+ti.
p $= \frac{1}{3}$ ti, ti 2 spine pairs. m=p, 2 spine pairs.
Colour light throughout except strong dark longitudinal marking on outer sides of c and tr.

3rd. Proportions as far as patella = *maxillosa.* Dark brown c to f, light beyond.

4th. c $> c_1$, cylindrical or very slightly wider at base.
tr $= \frac{2}{3}$ c, slightly barrel-shaped, both these joints are brown with longitudinal light centre line below.
f brown, slightly thicker at base.
Remainder missing.

The white or very light yellow anterior legs are very noticeable, as also the proportions of c_4 and tr_4.

Sternum.—Sharply but shortly pointed between $c_{1.1}$ which are in subcontact, short-pointed at sides between $c_{1\ 2}$ which are close, curves cut strongly between $c_{2.3}$ which are wider, narrows again before c_3 and then proceeds with straight parallel sides to c_4, in front of which it ends in a moderately long point. $c_{4:4}$ in contact. At widest sternum about $= c_2$. Colour dark mahogany.

PEDICEL.—Length > caput. 2nd joint considerably longer than 1st (as seen from above $j_2 = 2\,j_1$). 1st plate broader than 2nd and procurved behind. Pedicel received into very short projecting socket of opisthosoma.

OPISTHOSOMA.—Subcylindrical with constriction at $\frac{1}{3}$, widest at $\frac{2}{3}$, pointed at spinners. Dark green-brown above, with white marking at constriction starting at top of sides and widening below. In front of epigastric fold and behind the white marking colour is as above. Epigastric fold straight; lung-sacs wide apart and dark.

Epigyne.—An equilateral triangle with base along epigastric fold and vertex forward. Edges red, inside white, with central darker bridge and darkest spots at its edges. Not very distinct but more characteristic than others of the genus. (Text-fig. 5, *e*.)

Spinners.—Proportions as *maxillosa*. All a light brown colour.

♂. The chief differences from ♀ are:—

PROSOMA.—*Cephalothorax* = $\frac{3}{4}$ abdomen. Groove sharper at bottom and thorax does not rise so much behind it, so that it is considerably below caput and general shape not unlike *maxillosa*. Rim as well as wedge has grey hairs.

Falces = cephalothorax. From above inner edge straight at first, apical half concave, outer edge convex. Width $= \frac{1}{6}$ length. End cut off square, with strong concavity and very strong tooth-like projection forward and inward from inner angle, with blunt end. From side falces project straight forwards, with upper and lower edges almost parallel, granulated.

Groove not well defined. Upper margin has 6 teeth. 1st smallish close to base of unguis, remainder subequally spaced over basal half of falx, 2-5 being very large, 6 small = 1. Lower margin has 9 teeth, mere dots subequally spaced.

Unguis darkest and strongest at base, S curved with slight swelling of tip-curve. Length = paturon. (Text-fig. 5, *b*, *c*.)

Maxillæ.—Rather straighter outer edge and stronger serrula.

Palpi.—Trochanter = width maxilla. Femur = $\frac{1}{3}$ caput, less flattened than in ♀. Patella < trochanter, curved downwards; from above, sides almost parallel, apex distinctly wider than base. Tibia length = patella, much wider at apex. A very small blunt process on outer apical corner visible from below. Some longish hairs on inner side. Tarsus longer and broader than tibia, oblong, with short hairs on inner side. Fovea reaches to about $\frac{2}{3}$. Organs have a black spine springing from near inner apical end, encircling fovea outwards and backwards and terminating in a fine point pointing outwards at about middle of apex after completing somewhat more than a circle. (Text fig. 5, *d.*)

Legs.—4 considerably > 1; 3 missing but up to f = 2. Generally as ♀ except that in 2 anterior pairs there are strong black lines along sides of joints which are much strongest in femurs and the white centre lines of c_1 and tr_1 occupy the whole of the lower side, and ti_{-} has 3 spine pairs instead of 2.

OPISTHOSOMA.—Abdomen longer and narrower. Width = $\frac{1}{4}$ length. White marking at constriction only at sides. Above and below central brown coriaceous lines running nearly the whole length of the body.

SHORT DESCRIPTION.

Cephalothorax = abdomen in ♀ = $\frac{3}{4}$ abdomen in ♂. Caput = thorax, moderately high, with broad but shallow groove and thorax lower. Strong white-haired wedge at sides of groove, and ♂ white hairs along rim.

♀ falx: upper teeth 5 or 6, subevenly spaced, 3 above angle, moderate, remainder small; lower 8 or 9, close, small.

♂ falx = cephalothorax, subparallel edges, inner concave near apex and terminating in strong bow. Unguis, S curve, slight swelling near point, = paturon. Upper teeth 1 at base of unguis, 5 evenly spaced over basal half, of which 2 5 very strong. Lower 9 dots evenly spaced with dark ridge at base.

Sternum narrow, rounded between $c_{2.3}$, short points in front and between $c_{1.2}$, longer point behind, $c_{1.1}$ about $\frac{1}{4}$ their width apart.

Legs.—First 2 pairs white, black side-lined in ♂. Posterior dark with c_1 and tr_1 dark below, $c_1 > c_1$, $tr_1 = \frac{2}{3} c_1$. Order 4.1 (2.3?). p_1 1 spine below towards outer side, ti_1 4 spine pairs, m_1 2 spine pairs, ti_{-} ♀ 2 spine pairs (♂ 3), m_{-} 2 spine pairs.

Pedicel: 2nd joint notably longer than 1st.

Abdomen cylindrical, narrow, gently constricted at $\frac{1}{3}$, with white oblique lines down side, in ♀ extending below. ♂ has brown longitudinal centre above and below.

Epigyne an equilateral triangle.

♂ palpus: very small process at outer apical angle of tibia. Organs are encircled by a black spine pointing outwards at centre of apex.

General colour of prosoma dark mahogany with even darker eye-frame, of opisthosoma dark grey-brown.

Note.—The description is based on 1 ♂ and 2 ♀, one of the latter being much lighter in colour. The ♂ and this ♀ were both found at Bukit Besar, alt. 2500 ft., on tree-trunk 35 ft. from ground on 6 Sept. 1901: the other ♀ at Bukit Besar.

Ants accompanying, nos. 12 and 16.

The following measurements of the ♂ were taken:—

Length 8·0 mm., p.s. 3·1 × 2·0 × 2·0, o.s. 4·0 × 1·0.

Legs. 1	c+f 2·2,	p+ti 2·1,	m+ta 1·2	= 5·5
2	,, 2·0,	,, 1·7,	,, 1·1	= 4·8
3	,, 2·0,	missing		
4 ......c+tr 1·5,	f 1·7,	,, 2·2,	,, 2·0	= 7·4

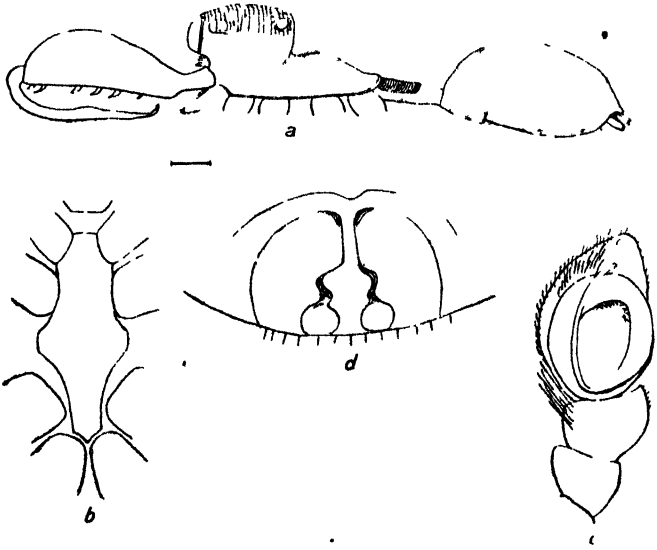
No measurements of ♀ legs were obtainable; total lengths of the two ♀ 5·8 and 5·0 mm.

MYRMARACHNE TURRIFORMIS, sp. n. (Text-fig. 6.)

♀. PROSOMA. (*a*) Length considerably > p + ti of 4th = p+ti+m+ta of 3rd = 2½ width = 2½ height. Caput < thorax. Front wall of caput straight or very slightly recurved, and stepped back at eye. Side walls straight. Back wall procurved as it slopes down to groove, which is narrowed above but practically full width at base. Thorax straight behind groove with slightest undulations to ⅔ where it narrows with straight edges to end, which is cut nearly straight and ⅓ to ½ width of thorax.

(*b*) Front wall, straight. Caput slightly convex and distinctly sloping upwards from eye 2 to 4, well rounded and steeply sloping to a broad groove, top of which is generally only about ½ height of caput. Thorax rises slightly behind groove to ¼ where it is

Text-figure 6.



Myrmarachne turriformis, sp. n.

a. ♂: Profile. *b*. ♂: Sternum. *c*. ♂: Left palpus from below.
d. ♀: Epigyne.

much lower than caput, and then with convex and concave slope to hind rim, which is weak but can be traced well towards caput.

Colour mahogany, slightly darkest on caput, which has black eye-frame sub-broken in front of eye 4 and terminating just below the line of eyes 2-4. Slight indication of grey-haired cephalic wedge.

Clypeus very low.

Eyes.—1st row straight or very slightly recurved by summits. 1 . 1 subcontact, 1 . 2 considerably $>$ 1 . 1, 2 = $\frac{1}{3}$ 1 and behind it. 2 . 3 very slightly $<$ 3 . 4. Eye square much broader than long and 2 . 2 distinctly $>$ 4 . 4 $>$ 4-rim. 4 projects over edge of prosoma but not at all prominently, and the prosoma is not convex over it on either view.

Falces Length $<$ $\frac{1}{2}$ caput = 2 breadth. Edges parallel, truncation somewhat short and square. Groove marked. Unguis light, with regular curve and regular diminution from base to apex, not very strong, length = $\frac{1}{2}$ paturon. Upper teeth 5 to angle, not quite in contact, with 1 or 2 dots wider spaced below. Lower teeth 6, as strong as upper, close, largest in centre, but no great difference in size.

Maxillæ. Length = c_1 = falx. Narrow at base, outer edge curving strongly and concavely outwards beyond labium to bold rounded corner. End square, truncation shortish, steep with strong light scopula, longest at apex. Inner edge slopes outwards from truncation, being strongly hollowed in front of and at side of labium. Dark serrula from about middle of outer edge to angle. Colour light.

Labium. Length $>$ $\frac{1}{2}$ maxilla, parallel sides, cut off square at end, a little darker than maxilla except at end. A slight dark scopula at truncation.

Palpi.—Spring from near base of maxilla. Trochanter length = $\frac{1}{2}$ maxilla. Femur $<$ $\frac{1}{2}$ caput, flattened, breadth in centre = $\frac{1}{3}$ length. Patella narrow at base, broad at end. Tibia = $1\frac{1}{2}$ patella, at base = width patella, at apex very much wider. Tarsus = 2 tibia. The tibio-tarsus plate a little $>$ femur, with inner fringe rather short. Colour = labium, with hairy parts of tibio-tarsus browny green.

Legs.—4 . 1 . 3 . 2, with marked steps between each.

1st. c white, length $<$ 2 breadth, very slightly tapering.
tr white, cylindrical, length = breadth $<$ least width of c, faint.
f light yellow, lightest at apex, dark-lined on outer side, length $>$ 2 (c + tr), clubbed at base.
p = $\frac{1}{3}$ ti, light, thin dark line each side, 1 spine pair below.
ti = f, coloured as p, 5 spine pairs evenly spaced and about equal strength.
m light, dark-lined on side, 2 spine pairs in basal half, at least as strong as ti spines, last reaching well on to ta.
ta = $\frac{3}{5}$ ti, light, m + ta = $\frac{2}{3}$ (p + ti).

2nd. c white, length = $\frac{2}{3}$ c_1 > breadth, considerably stouter at base.
tr as tr_1.
f light, slightly clubbed at base, > 2 (c + tr).
p = $\frac{1}{4}$ ti, light, faint dark side-lines.
ti < f, light with dark side-lines, 3 spine pairs evenly spaced nearly as strong as on ti_1.
m slightly > ta, light, 2 spine pairs nearly as strong as on ti.
ti light, ti + ta slightly < ti.
3rd. c brown, cylindrical, > c_2, length = 2 breadth.
tr = $\frac{1}{2}$ c, brown, length slightly > breadth, slightly wider at apex than base.
f lighter brown, = f_2, very slightly clubbed at base.
p brown, light at base, < $\frac{1}{3}$ ti.
ti light with dark lines at sides, p + ti > f.
m & ta light, m + ta < p + ti.
4th. c light with dark above and sides, length = 2 breadth, > c_1, very slightly wider at base than apex.
tr cylindrical, light with dark above and sides, nearly as long as c and much > any other tr.
f = 2 (c + tr), brown, very slightly wider at base than apex.
p light with apex dark above, = $\frac{1}{6}$ ti.
ti light brown, p + ti > f.
m lighter, nearly as long as ti, light.
ta = $\frac{1}{3}$ m, light.

In general appearance the anterior legs are lighter than the posterior.

Sternum.—Truncated between $c_{1.1}$ and stoutly and bluntly pointed between $c_{1.2}$, spreads out into an advanced point between $c_{2.3}$, which are rather widely separated, a long point in front of $c_{4.4}$, which are in subcontact. Greatest width > width of c_1, $c_{1.1}$ = nearly width of c_1. Colour mahogany, darker than any other part of prosoma. (Text-fig. 6, *b*.)

Pedicel.—Slightly < caput; 1st joint brown, slenderer and very much longer than 2nd, light with dark sides and front, very short, inserted into socket on opisthosoma.

Opisthosoma = or very slightly > prosoma. Breadth and height nearly $\frac{1}{2}$ length. Pear-shaped, widest at $\frac{1}{3}$. White belt at about $\frac{1}{4}$, distinctly in front of widest part. Lung-sacs brown, wide apart, lighter brown rest in front of epigastric fold, which is slightly procurved. General colour brownish green.

Epigyne.—No distinct formation, but in some specimens a light circle with faint brown bridge ending basally in a dark bifurcate; general appearance is sometimes something like the ace of clubs. (Text-fig. 6, *d*.)

Spinners.—1st pair stoutest. Basal joint short, thick, light with dark longitudinal markings; 2nd joint larger, slightly barrel-shaped, thinner. 2nd pair white, thinner. 3rd pair darker than 2nd, 2nd joint much longer than 1st.

Anus.—Two segments, rather prominent.

♂. The chief differences from ♀ are :—

PROSOMA.—Caput very much higher and back wall nearly vertical, so that caput is about three times as high as groove and twice as high as thorax, standing up like a square tower (text-fig. 6, *a*).

Eyes.—4-rim = 4 . 4 or very nearly.

Falces.—Longer than prosoma, after an initial sharp constriction at top they curve outwards to $\frac{2}{3}$ and then in; end cut square but somewhat pointed forward at inner corner in continuation of straight inner edge. On side view upper edge is convex, widest at centre, lower straight. Width = $\frac{1}{5}$ length. Nearly horizontal. Unguis, length slightly < paturon, S curve with branches much flattened but sharp curve at tip, considerably thicker and darker at base than tip. Groove not defined. Upper margin contains 7 teeth, of which the first 2 are close to base of margin, the 4 at least are strong and subevenly spaced, the last a little weaker. Lower margin 6 or 7 teeth, very small, and much further apart at apical than basal end, but teeth a little variable.

Palpi.—Tibia only a little larger than patella, with moderately strong pointed black-tipped process on upper outer apex. Tarsus has fovea large and extending nearly to the end, with a fine spine encircling rather more than once.

Legs.—The contrasts of colouring are not nearly so distinct as in ♀.

OPISTHOSOMA.—White belt missing. Upper and centre of lower sides coriaceous.

SHORT DESCRIPTION.

Prosoma = opisthosoma. Caput = thorax. Caput very high with nearly vertical walls, tower-like in ♂, not so marked in ♀. Occasionally faint white-haired cephalic wedge.

♀ falx. Upper teeth 5 to angle with 1 or 2 dots beyond; lower teeth 6, as strong as upper, close.

♂ falx. Longer than prosoma, width $\frac{1}{5}$ length, outer edge convexly curved on upper and side aspect. Upper teeth 6 or 7, of which first two comparatively close to root of unguis. Lower 6 dots wider spaced at root of unguis. Unguis slightly < paturon, flat S curve with rather sharp curve at point.

♀ palp. Tarsus = 2 tibia.

♂ palp. Tibia has moderate, black-pointed, slightly curved process at outer upper apex. Organs surrounded by circle and a bit of thin black spine.

Legs 4 . 1 . 3 . 2, with marked difference between each 2; anterior pairs lighter than posterior, but not always in ♂, dark side-lines in some joints. p_1 1 spine pair; ti_1 5 spine pairs, evenly spaced, not very strong; m_1 2 spine pairs; ti_2 3 spine pairs nearly as strong as on ti_1; m_2 2 spine pairs nearly as strong as on ti_2.

Pedicel nearly as long as caput, 2nd joint very short as compared with 1st.

Opisthosoma. Fusiform, not constricted. White belt at about ¼ in ♀, missing in ♂.

General colour of prosoma lightish mahogany with black eye-frame, of opisthosoma dark greeny brown.

Note.—The description is based on 12 ♀ and 8 ♂, all from Bukit Besar and Talum. Nos. 93 ♀ and 94, 95 ♂ were all in same tube, and this fact as well as the general resemblance is evidence of identity of species.

The following measurements were taken:—

♀ 5·0 mm., p.s. 2·3 × 1·2 × 1·2, o.s. 2·4 × 1·4 × 1·2.
Legs. 1...... c+tr+f 1·7, p+ti 1·5, m+ta 1·1 =4·3
2...... „ 1·0, p+ti+m+ta 2·5 =3·5
3...... „ 1·4, p+ti 1·0, m+ta missing
4......c+tr 0·9, f 1·8, „ 1·9, „ 1·1 =5·7

♂ 5·2 mm., p.s. 2·4 × 1·4 × 2·0, o.s. 2·4.
Legs. 1...... c+tr+f 2·2, p+ti 2·4, m+ta 1·8
2...... „ 1·6, „ 1·8, „ 1·1
3...... „ 2·1, „ 1·8, „ 1·7
4...... c+tr 1·1, f 2·0, „ 2·3, „ 2·2

The lengths of the specimens varied from 5·2 to 3·7 mm., the ♂ being on the average slightly longer than ♀.

Ants accompanying, nos. 4, 14, 15, 17.

♀. MYRMARACHNE CUNEATA, sp. n. (Text-fig. 7.)

PROSOMA. —(*a*) Length $= p_1 + tr_1 + m_4 + ta_1$ nearly, slightly > opisthosoma. Caput = thorax. Front wall slightly projecting in centre and stepped back to eyes 2. Side walls straight, very slightly approaching backwards. Back wall strongly projecting at centre into bridge. Bridge narrowed at top, only very slightly at base, though it is liable to appear so owing to white wedge. Thorax edges curve very slightly outwards to ½, then inward to rear, which is cut off convexly straight.

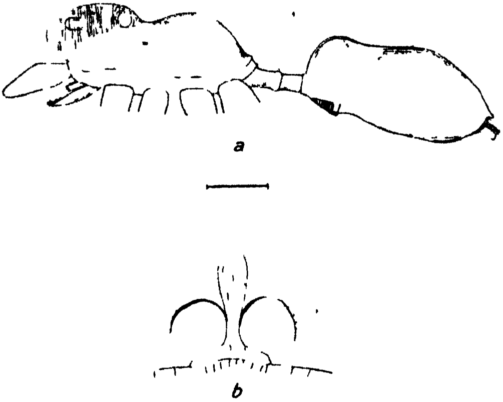
(*b*) Front wall vertical, top of caput straight and level, groove shallow and broad, bottom not below eye 4. Thorax rises behind to above half way up eye 4 at ⅓ and then slopes convexly backwards to rim, the final concavity before rim being negligible. Rim rather marked and traceable round to caput.

Colour medium mahogany, lightest at sides and much darkest at top of caput. Eye-frame black, rather broader than usual and very distinctly broken between eyes 3 and 4. A very strong white wedge on either side of bridge, smooth and not due to hairs.

Eyes.—1st row straight by summits, 1 . 1 and 1 . 2 subcontact, 2 slightly behind 1. 2 = ½ 1. Eye square slightly broader than long and sides slightly approaching backwards. 2 . 3 very slightly < 3 . 4, 4 = or very slightly > 2. 4 projects but not markedly so, and 4-rim very much < 4 . 4.

Falces.—Project nearly horizontally forward by lower edge, visible from above, length $> \frac{1}{2}$ caput, upper edge strongly convex being subangular at $\frac{1}{3}$, length $=$ 2 breadth. From above edges subparallel, outer being slightly convex. Upper teeth 6, 1 basal close to root of unguis, small and liable to be missed; 2.3.4.5 largest with increasing spaces, 6 beyond angle very small. Lower teeth 6, strong, close, from base of unguis to level with 5 of upper. Thickish light upper scopula longest at angle; thin dark lower. Unguis rather strong. Colour lighter than cephalothorax, glabrous.

Text-figure 7.



Myrmarachne cuneata, sp. n., ♀.

a. Profile. *b*. Epigyne.

Maxillæ.—Length $= c_1 + tr_1 =$ falx nearly. Outer edges parallel to end of labium, then inclined straight outwards to rounded outer corner. Serrula at end only, which is slightly rounded. Truncation long, very oblique, with very strong black scopula. Below scopula inner edge hollowed in front and at side of labium. Colour light.

Labium.—Length $>$ 2 breadth, parallel sides, slightly constricted at middle; strong dark scopula.

Palpi.—Spring from near base of maxilla. Tr $=$ width maxilla: f $= \frac{1}{2}$ caput, parallel sides, rounded ends, flattened, length $<$ 3 breadth; p $= \frac{1}{2}$ f, broadening to apex from narrow base. Ti $<$ 2 p, broadens from base to apex, which is 2 width p apex. Ta very slightly $>$ ti, rounded end; the two together making a plate $=$ 2 f, hairy on both edges. Total length of palpus when extended $=$ 2 falx.

Legs.—Order 4.1.3.2, with all differences marked.

1st. c white, length $= 2\frac{1}{2}$ width, parallel or very slightly tapering.
tr white, with sometimes dark patch on outer side; breadth $=$ length $= \frac{1}{4}$ c.

f white, strong black side-lines, clubbed at base, = ti.
p = $\frac{1}{3}$ ti, white with dark side-lines, 1 spine pair.
ti white with dark side-lines, 7 spine pairs, or 7 and 6, last 3 or 4 pairs all terminating about level at end of joint.
m light, > p, 2 spine pairs, of which last reaches to middle of ta.
ta light = $\frac{1}{3}$ m.
2nd. c brown, strongly swollen at centre, length = breadth.
tr broader than long, brown except for patch of white on fore side.
Other joints, proportions, and colours as 1st, but are slightly greater in proportion, and ta only slightly < m.
ti has 3 spine pairs, m 2 pairs.
3rd. c a little > c_2, brown.
tr short, cylindrical, brown.
f > ti < p+ti, brown, very slightly clubbed at base.
p = $\frac{1}{3}$ ti, curved downward, light except above apical end.
ti brown, slender, slightly lighter at end.
m nearly = ti, light, darker shading at basal sides.
ta = $\frac{1}{2}$ m, light.
4th. c < c_1, brown except for light below.
tr much longest, white with dark basal side-markings, cylindrical, > c.
f brown, slightly clubbed.
p white except for brown above at base and apex, =$\frac{1}{4}$ ti.
ti brown, lightest at apex.
m brown, nearly = ti.
ta white, < $\frac{1}{3}$ m.

The light c_1 and tr_1 and tr_1 are very noticeable, as also the dark side-lines on the light anterior legs.

Sternum.—Blunt-pointed behind $c_{1.1}$, which are about $\frac{1}{4}$ their width apart, and between $c_{2.3}$. Wider and pointed close behind c_2, attempt at a point at c_3, and then tapers to long point in front of $c_{4.4}$, which are in contact. At widest point =c_2. Colour dark mahogany.

PEDICEL.—Short = $\frac{1}{2}$ caput, rather stout. Joints about equal, first very slightly longer.

OPISTHOSOMA.—Middle thickest, constricted at $\frac{1}{4}$. Brownish green with white transverse band at constriction, somewhat lighter below, with longitudinal central portion bordered by faint white lines from epigyne to spinners. Lung-sacs dark, wide apart. Epigastric fold procurved.

Epigyne.—A lighter semicircle in front of epigastric fold, in the centre of which is a dark marking somewhat hourglass-shape (text-fig. 7, *b*).

Spinners.—1st brown, thickness slightly greater at base than apex. 2nd longer, thinnest, lighter, cylindrical. 3rd as light as 2nd, slightly thicker, subcylindrical.

SHORT DESCRIPTION.

Prosoma very slight, longer than opisthosoma. Cephalic groove broad and shallow, caput not very much higher than thorax. A strong white wedge not due to hairs at sides of groove.

Falces nearly horizontal by lower edge. Upper teeth 6, with 4 middles much largest. Lower teeth 6, strong, close. Ta of palp = or very slightly > ti.

Legs 4 . 1 . 3 . 2, with all differences marked. 1st has white c and tr, and 4th white tr larger than c. The anterior legs are light with strong dark side-lines f to ti. p_1 has 1 spine pair, ti_1 7 pairs or 6 . 7, m_1 2 pairs. Ti_2 has 3 spine pairs, m_2 2.

Pedicel shortish, with j_1 very slightly > j_2.

Opisthosoma has thin white belt at $\frac{1}{4}$ and is widest at $\frac{2}{3}$ back.

Notes.—Description based on 4 ♀ found at Bukit Besar 3500 ft., Talum 4000 ft., and Gedong. One of the specimens only (from Bukit Besar) is accompanied by its mimicked ant of species no. 2. The type-specimen is rather lighter than any of the others. Differences from specimen to specimen are very slight. In one tr_1 has a distinct dark exterior marking not visible in the others. The sternum point is rather unusually far from the base of the labium. The cephalic wedge is always very noticeable and serves as a recognition mark.

This species is in many ways very like *Myrmarachne maxillosa*, but it may be distinguished without difficulty by general shape of prosoma and opisthosoma, which are less squat, teeth of lower margin, white cephalic wedge, larger pedicel, and shape of sternum, which is pointed instead of undulated between coxæ and constriction of opisthosoma.

Total lengths 7·8, 7·6, 7·3, 6·2 mm.

Legs of specimen 6·2 mm. long :—

1......	c+tr 1·0,	f 1·9,	p+ti 2·3,	m+ta 1·1	=6·3
2......		c+tr+f 1·8,	„ 1·9,	„ 1·0	=4·7
3......		„ 2·1,	„ 1·9,	„ 1·8	=5·8
4......	c+tr 1·1,	f 2·1,	„ 2·5,	„ 2·1	=7·8

Ants accompanying, no. 2.

♂. MYRMARACHNE RAMOSA, sp. n. (Text-fig. 8.)

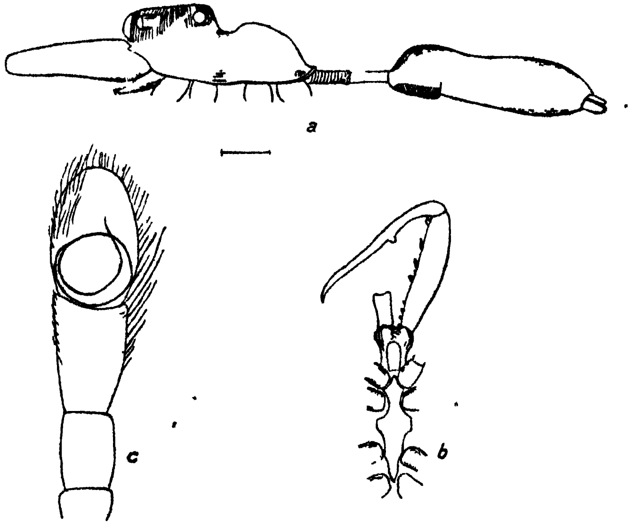
PROSOMA.—(*a*) Length = $p_3+ti_3+m_3+ta_3$ nearly, slightly > opisthosoma. Caput = thorax. Front wall recurved, not stepped back to eye 2. Sides straight or very slightly convex, parallel. Back wall straight with well rounded corners. Thorax joined across groove by distinct paralled-sided bridge which appears from above as a sharp constriction, though groove at base is nearly as wide as caput. Thorax swells out at sides to about $\frac{1}{3}$, and then narrows with slightly convex and concave slopes to end which is cut square.

(*b*) Front wall of caput nearly vertical but with very slight forward batter; top straight sloping very slightly up to eye 4, over which it is rounded. Back wall slopes straight down to narrow groove, height = $\frac{1}{2}$ caput. Thorax slopes slightly up to $\frac{1}{3}$ and then convexly and concavely to end where is rim, which can be traced round to caput.

Colour mahogany, darkest on caput. Black eye-frame widely broken between 3 and 4. Faint light haired wedges at sides of groove.

Eyes.—1st row slightly procurved by summits. 2=$\frac{2}{5}$ 1. 1.1 an appreciable gap, 1.2 slightly wider. Eye square markedly wider than long and very slightly wider at 4.4 than 2.2. 2.3 distinctly $<$ 3.4, 3 below upper tangent to 2.4, 4 $>$ 2 and lighter in colour, projects over edges. 4-rim $<$ 4.4.

Text-figure 8.



Myrmarachne ramosa, sp. n., ♂.

a. Profile. *b.* Sternum &c. *c.* Right palpus from below.

Falces.—Longer than caput $<$ prosoma. Length = 3 width. Inner edge straight with black ridge, outer convex with black ridge. End hollowed, with outer angle sharp, inner chamfered. On side view much deepest just beyond base, decreases considerably to apex, upper edge being straight and lower slightly hollow. Unguis long and tip reaching beyond end of maxillæ, flat S curve, with short branch or knob at $\frac{1}{3}$. Groove non-existent and upper and lower teeth liable to be mixed up. Upper teeth 9, of which that nearest to unguis is strongest, the next 5 are spread over the paturon with gap in centre largest, last teeth closer, smaller, and overlapping maxillæ. Lower teeth about 10, small, spread over length of paturon but closer at apical end. The two rows of teeth are notably crooked (text-fig. 8, *b*).

Maxillæ.—Length $= c_1 + tr_1$. Outer edges parallel to end of labium, then inclined outwards to well rounded corner and slightly convex with truncation 45°; strong dark scopula. Below scopula inner edge hollowed in front and at sides of labium. Serrula. Colour light mahogany.

Labium.—Length > 2 breadth, parallel sides, broadly and very slightly constricted near apex, end slightly hollowed, dark scopula. Dark mahogany, light at apex.

Palpi.—Spring from near base of maxilla. Tr > width maxilla. $f = \frac{1}{2}$ caput, parallel sides, somewhat reduced at ends and slightly flattened. $p < tr < \frac{1}{2} f$, broadening to apex from narrow base. Ti only a little > p above, = nearly 2 p below, slightly broadened from base to apex; short, small, blunt, light straight process at outer lower apex, largish hairs on inner edge. Ta a little > ti, blunt, suboblong. Fovea occupies little more than basal half. Organs have a fine black spine springing from outer basal rim of fovea passing backwards and inwards with double spiral, and finally pointing forward rather on inner apical rim (text-fig. 8, *c*).

Legs.—4 . 1 . 3 . 2, with difference between 3 and 2 only slight.

1st. c length > 2 breadth, rather markedly tapering, brown.
  tr narrower, slightly tapering, $< \frac{1}{2}$ c, brown.
  f clubbed at base, = ti, brown, darkest above.
  $p = \frac{1}{3}$ ti, slight, curved, light, shaded at sides.
  ti 4 spine pairs, with sometimes a fifth very small, light, dark at sides.
  $m = 1\frac{1}{2}$ p, 2 spine pairs near base and apex, basal much largest.
  ta $< \frac{1}{2}$ m, dark.

2nd. c much shorter, gibbous at base, lighter.
  tr cylindrical, $< \frac{1}{2}$ c, light with shaded sides.
  $f < f_1$, only a little thicker at base than apex, lighter, but side-lines darker especially fore.
  p = nearly $\frac{1}{2}$ ti, strong especially at apex, slightly curved, light.
  ti light, 3 spine pairs.
  m = p, 2 spine pairs, light.
  ta $< \frac{1}{2}$ m, light.

3rd. c, tr, f as 2nd, but dark all over. p, ti, m, ta slightly lighter than these. $p = \frac{1}{3}$ ti nearly, m = ti, ta $< \frac{1}{2}$ m.

4th. $c = c_1$, cylindrical, very slight tapering.
  tr = c, cylindrical, both c and tr lighter than 3rd and dark at sides.
  f brown, nearly = p + ti.
  $p > \frac{1}{2}$ ti, light, with dark apex above and at sides.
  ti, brown; m = ti nearly, slenderer, and back lighter at apex.
  ta $< \frac{1}{2}$ m, light.

On the whole the legs strike one as dark, none of the coxæ or trochanters being really light.

Sternum.—Blunt-pointed between $c_{1.1}$, which are about $\frac{1}{2}$ width apart, blunt-pointed between $c_{1.2}$, which are not in contact, swells out with straight edges between $c_{2.3}$, which are wide, and tapers to moderately long point in front of 4.4, which are in contact. Widest $= c_2$. Dark mahogany as coxæ.

PEDICEL nearly equals caput. j_1 brown, longer than j_2, below $= 2 j_2$. j_2 light with black fore end.

OPISTHOSOMA = prosoma. Thin and round with broad constriction at $\frac{1}{4}$. Brown above and below in front of epigastric fold, which is slightly recurved. General colour very dark.

Spinners.—1st light, stoutish, barrel-shaped. 2nd lighter, slenderer, cylindrical. 3rd longest, darker, slender, cylindrical.

Anal tubercle.—Prominent, 2-jointed.

SHORT DESCRIPTION.

Prosoma = or slightly < opisthosoma. Cephalic groove rather narrow, with thorax about half height of caput and wedge of white hairs not very strong.

♂ falx longer than caput < prosoma, flattened above. Unguis as long as paturon, flat S curved, with very short knob-like branch. Upper teeth 9, lower 10, but lines liable to be confused.

♂ palp = or nearly = falx. Tibia has short blunt process at outer lower apex. Organs have a spine twisted spirally twice and terminating pointing straight forward at inner apex.

Legs 4.1.3.2 with difference 3.2 slight, no very marked colour contrasts. Tr_1 4 spine pairs, m_1 2 pairs, ti_2 3 pairs, m_2 2 pairs.

Pedicel nearly = caput, with 1st joint markedly greater than 2nd, especially below.

Opisthosoma widely constricted at $\frac{1}{4}$, with longitudinal brown coriaceous marks above and below and in front of epigastric fold.

Note.—Description is based on 4 ♂ from Bukit Besar and Biserat, two of the specimens from the latter associated with ants nos. 9 and 16 respectively. There is not much difference between specimens except some variation in intensity of leg colouring.

Measurements:—

Total lengths 5·0, 5·2, 5·4, 5·8 mm. ex falces.

Legs of specimen 5·2 mm. long:—

1......	c+tr 0·8,	f 1·2,	p+ti 1·9,	m+ta 1·2	=5·1
2......	„ 0·6,	„ 1·2,	„ 1·3,	„ 1·0	=4·1
3......	„ 0·8,	„ 1·2,	„ 1·3,	„ 1·2	=4·5
4.....	„ 1·0,	„ 1·7,	„ 2·0,	„ 1·9	=6·6

♀. MYRMARACHNE ALBICRURATA, sp. n. (Text-fig. 9.)

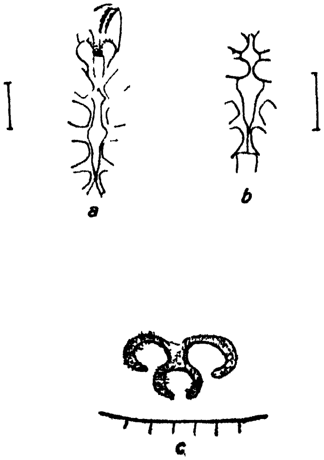
PROSOMA.—Length = opisthosoma = $p_4 + tr_4 + m_4$. Greatest breadth distinctly > greatest height. Caput = or slightly <

thorax. Front very slightly recurved, slightly stepped back to eyes 2. Side walls very slightly convex and tapering outwards towards eyes 4. Back wall strongly procurved at groove, which is strongly constricted above and much less so below. Thorax curved rather strongly outwards from groove to slightly in front of centre and then inwards to rear, which is cut nearly square. Rim dark.

Caput somewhat convex and higher behind than before. Slopes at moderate angle behind, with groove low and < half height of caput and broad. Thorax rises to about ⅓ and then falls convexo-concavely to turned-up but not abrupt rim, which is dark and traceable round to caput. A slight white wedge at thoracic groove. The general shape is well rounded at angles.

Colour light mahogany, with black eye-frame broken in front of 4 and with lower boundary not so well defined as usual.

Text-figure 9.



Myrmarachne albicrurata, sp. n., ♀. *M. lateralis*, sp. n., ♀.

a. Sternum &c. of *M. albicrurata*. *b*. Do. of *M. lateralis*.
c. Epigyne of *M. lateralis*.

Eyes.—1st row straight, intervals 1.1 and 1.2 slight and about equal. Eye square broader than long, parallel sides. 3 midway between 2 and 4. 4 > 2. 4.4 distinctly > 4-rim.

Falces.—Length = ⅔ caput, nearly parallel with inner edge, very slightly convex, length = 2½ breadth. Side view strongly convex or rather angular at nearly ½, base almost horizontal. Groove marked, both outer and inner scopulæ lighter and thinner than usual. Upper teeth 8 or 9, slightly irregular in size and spacing; lower 8 or 9 closer, especially away from root of unguis.

Maxillæ = *cornuta*, very light in colour; scopula dark, strong.

Labium = *cornuta*, very slightly darker than maxillæ; scopula light, strong.

Palpi.—Spring from near base of maxilla. Length of trochanter = narrowest width maxilla. Femur < $\frac{1}{2}$ caput, flattened with rounded ends, of which basal is slenderer. Patella about = trochanter. Tibia slightly < tarsus. Usual shape, but tarsus slightly more pointed and hairs even on inner edge rather scanty. Joints to femur white, patella to end much lighter than usual.

Legs.—4 . 1 . 3 . 2 with 3 nearly = 1.

1st. c cylindrical, length = 2 breadth, white.

tr length < width c, narrower, white with slight brown longitudinal marks on inner side.

f nearly = caput, slightly widened at base but not clubbed, white with dark longitudinal side-marking near basal half of fore side.

p = $\frac{1}{3}$ ti, light with dark side-lines, no spines.

ti > f. 4 spine pairs moderate, evenly spaced and subequal, but 3rd rather the strongest, white with dark side-lines.

m = p, 2 spine pairs of which first is as strong or stronger than 3rd of ti, white.

ta very slightly < m, white.

2nd. c length = $\frac{1}{2}$ c_1 = breadth, gibbous, white.

tr length = $\frac{1}{2}$ c = breadth, white.

f < f_1, white.

p > $\frac{1}{2}$ ti, white.

ti 2 spine pairs, p + ti = or < f, very slight dark side-line, white.

m 2 spine pairs, white.

ta very slightly < m, white, m + ta = p + ti.

3rd. c slightly > c_2, brown, less gibbous.

tr > $\frac{1}{2}$ c, brown, darkest at sides.

f > f_1, slightly broader near base, brown.

p > $\frac{1}{2}$ ti, light with brown above distally.

ti light with dark sides most marked at base, p + ti slightly > f.

m slightly > ti, white.

ta < m, m + ta distinctly > p + ti.

4th. c distinctly > c_1, with same proportions, light with dark sides.

tr nearly = c, slenderer, white with dark markings at side, of which fore much the stronger.

f long, slightly clubbed, brown.

p = $\frac{1}{3}$ ti, white, brown above distally.

ti brown except for slight white continuation of p below. p + ti distinctly > f.

m long, light except for slight darkening at basal sides in continuation of ti.

ta = $\frac{1}{3}$ m and very slightly darker.

Sternum.—Short-pointed between $c_{1.1}$, which are < ¼ width apart, and between $c_{1.2}$, extends to sides between $c_{2.3}$, which are very wide apart, contracted between $c_{3.4}$, and the point, which is not well marked, is met between $c_{4.4}$, which are not quite in contact, by a very fine pointed projection from the fore lorum of the pedicel. Greatest width = c_4. Brown.

PEDICEL = ½ caput. $j_1 > j_2$, very much so below; above the fore lorum is slightly broader and longer than the second, below much stronger and broader and extended forward into a very long fine point.

OPISTHOSOMA. Subcylindrical, length = 3 or 4 breadth, broadly but not deeply constricted at ⅓. Dark green, with faint white oblique markings at constriction and suggestion of white markings below. Lung-sacs brown and wide apart. Epigastric fold recurved, very clear cut.

Epigyne.—Immature.

Spinners.—1st much thickest, barrel-shaped, dark. 2nd about same length, very thin, white. 3rd about same length, very slightly thicker than 2nd, darkest.

Anal tubercle.—Moderate.

SHORT DESCRIPTION.

Prosoma = opisthosoma. Groove rather deep but broad, and thorax not rising much behind it. Constriction appears rather sharp from above, cephalic wedges slight and with a very few white hairs.

Ta of palp a little > ti.

Legs 4.1.3.2 with 1 and 3 nearly equal. The anterior legs are almost white as are the coxæ of 4. tr_4 as long as c_4 but thinner, white with dark sides. c_4 greatest coxa. p_1 no spine, ti_1 4 spine pairs, ti_2 2 pairs. The backward point of sternum met by a very long and narrow point reaching forward from under side of pedicel. Legs 1 about ¼ their width apart; legs 4 not quite in contact.

Pedicel = ½ caput. $j_1 > j_2$.

Opisthosoma subcylindrical, broad but shallow constriction at ⅓, with faint oblique white markings sometimes evanescent.

Note.—Description based on 3 immature ♀ from Ban Sai Kau, Nandock, and K. Mahek, Jalor, only one of which was in good condition.

Measurements 5·7, 5·6, and 4·5 mm.

Legs of specimen 4·5 mm. long:—

1 ……	c+tr+f 1·1,	p+ti 1·4,	m+ta 1·0	=3·5
2 ……	„ 1·0,	„ 0·9,	„ 0·9	=2·8
3 ……	„ 1·1,	„ 1·1,	„ 1·1	=3·3
4 ……	c+tr 1·0, f 0·9,	„ 1·7,	„ 1·5	=5·1

No ants accompanying.

It is quite possible that this species and the following one may be identical; the grounds on which I keep them apart provisionally are

(1) *Shape of sternum* (text-fig. 9, *a*, *b*).—In *M. lateralis* legs 2 are as close to one another as legs 1; in *M. albicrurata* they are normal.
(2) *Spine pairs.*—*albicrurata*, p_1 no spines, ti_1 4 prs., ti_2 2 prs. *lateralis*, p_1 1 spine, ti_1 5 prs., ti_2 3 prs.
(3) *albicrurata* light in colour, *lateralis* dark.

Of two specimens, however, which were much damaged and cannot be certainly identified, I found in the first (collector's number 4) agreement with *albicrurata* in (1) and (3) and with *lateralis* in (2); while the other (collector's number 92 A) agrees with *albicrurata* in (1) and (2) and with *lateralis* in (3).

♀. MYRMARACHNE LATERALIS, sp. n. (Text-fig. 9.)

PROSOMA.—Length $\overset{=}{<}$ opisthosoma $= ti_1 + m_1$. Caput = thorax. Caput hardly stepped back at eyes 2, well rounded at rear corners. Bridge rather broad at top and only very slightly constricted below. Thorax spreads out behind to widest at ⅓, well rounded.

Groove shallow but broad, with rim thin. Thorax considerably lower than caput.

Colour dark, almost black on caput, strong wedge of white hairs.

Eyes.—1st row procurved, intervals slight but perceptible. 1 = 3 times 2. 2.3 = 3.4, 3 very small and rather above inner tangent to 2.4. 4 = 2. 4.4 > 4-rim. Eyes 2 and 4 rather prominent.

Falces.—Length = ½ caput, nearly horizontal, sides subparallel, slightly convex outside at distal end. On side view straight below, strongly convex above, with angle at ⅓ to ½. Teeth 7 or 8, largest at centre, falling in size both ways. Lower 8 or 9 close, largest at centre, smaller than upper. Moderate greyish outer scopula. Inner a few dark hairs.

Maxillæ, labium = cornuta.

Palpi.—Spring from base of maxilla. Tr = width of maxilla at narrowest; femur flattened, < ⅓ caput, reduced and rounded at ends, greatest width = ⅓ length. p very slightly larger than tr, expands distally. Ti and ta form flat plate, hairy especially on inner edge. Ta > f > ti, but differences not great.

Legs.—4.1.3.2.

1st. c claviform, length < 2 breadth, brown.
  tr < width of c, light with strong dark side-markings.
  f long, claviform, light with dark side-marks very broad at base.
  p > ⅓ ti, light with dark side-marks, 1 spine below at ⅔.
  ti < f, light with dark side-marks; spines 5 pairs, or 5 fore and 6 aft, the 3rd considerably strongest.
  m much < ti and darker, 2 spine pairs of which 1st is very strong.
  ta = ½ m, dark at base, light at tip.

2nd. c white, < c_1, gibbous.
tr white, < $\frac{1}{2}$ c.
f white.
Other joints marked as 1st but much lighter.
p = $\frac{1}{3}$ ti, ti 3 pairs of spines, m > $\frac{1}{2}$ ti 2 prs., ta > $\frac{1}{2}$ ti.
3rd. c & tr considerably stronger than in 2nd, dark brown.
f slightly clubbed, dark brown.
p brown but very slightly lighter, = $\frac{1}{3}$ ti, a long hair above at distal end.
ti dark brown, stout, < f.
m slightly > ti and slenderer, dark at base, lighter toward apex.
ta light, > $\frac{1}{3}$ m.
4th. c largest, light centre strip below, otherwise dark.
tr light with dark sides, at any rate apically, cylindrical, = c.
f long and dark, very slightly clubbed at base.
p light except for apex above, = $\frac{1}{4}$ ti.
ti dark, < f.
m dark, slightly < ti and thinner.
ta = $\frac{1}{3}$ m, lighter.

Sternum.—Short-pointed between 1 . 1, which are very close, and between 2 . 2, very strongly contracted between 2 . 2, which are very close, swells out with boss between 2 . 3, which are well separated. Tapers between 3 . 3 to a point in front of 4 . 4, which are as far apart as 1 . 1. Greatest width = c_2. Dark brown.

PEDICEL = caput. j_1 much > j_2.

OPISTHOSOMA.—Fusiform, slightly constricted at $\frac{1}{4}$, widest a little behind middle. Dark greenish, with thin oblique white markings at sides of constriction extending well back below. Epigastric fold straight to procurved; lung-sacs wide and region between them hairy.

Epigyne.—A dark horseshoe enclosing a central fork. (Text-fig. 9, *c.*)

Spinners.—1st barrel-shaped, dark. 2nd lighter, longer, thinner. 3rd cylindrical, < 2nd, darkest.

Anal tubercle.—Two-jointed, not very marked.

SHORT DESCRIPTION.

Prosoma well rounded, with broad shallow groove and caput considerably higher than thorax. Cephalic wedge of strong white hairs but not very broad.

Falces nearly horizontal, with teeth upper 7 to 8 and lower 8 or 9, the latter close and much smaller than the upper.

Legs 4 . 1 . 3 . 2, with 4 much the longest. p_1 has a single spine, ti_1 5 pairs on 5 and 6, m_1 2 prs., ti_2 3 prs., m_2 2 prs. 2nd legs white, 1st white except coxæ.

Sternum well rounded, both $c_{2.3}$, $c_{1.1}$ very close, more so than $c_{1.4}$, $c_{2.3}$ wide.

Pedicel = caput. j_1 much > j_2.

Opisthosoma = prosoma, fusiform, constricted at $\frac{1}{4}$ and with oblique narrow white stripes commencing at sides of constriction.

Note.—Description based on 2 ♀ from Bukit Besai and Sungkei. Lengths 6·2, 6·3 mm.

The following measurements are from the specimen 6 2 mm. in total length:—

1......	c+ti 0·9,	f 1·2,	p+ti 1·8,	m+ta 1·1	=5·0
2......	„ 0·6,	„ 0·9,	„ 1·3,	„ 1·0	=3·8
3......	„ 0·6,	„ 1·0,	„ 1·4,	„ 1·4	=4·4
4.. ...	„ 1·1,	„ 1·9,	„ 2·1,	„ 2·0	=7·1

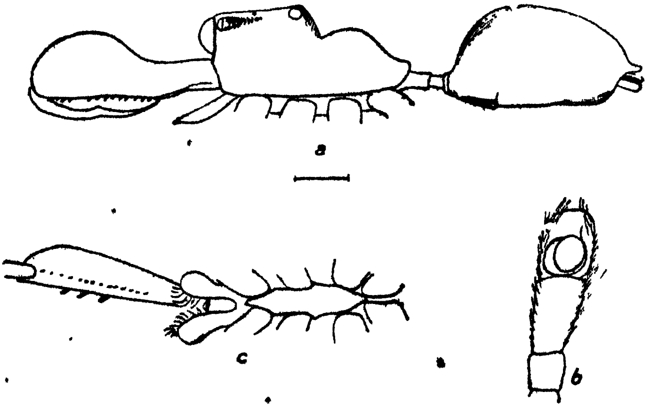
No ants accompanying.

♂. **MYRMARACHNE BISERATENSIS**, sp. n. (Text-fig. 10.)

PROSOMA.—(*a*) Length slightly > opisthosoma = $p_2 + ti_2 + m_2 + ta_2$. Greatest height and greatest breadth each = $\frac{1}{2}$ length. Caput = thorax. Front wall very slightly recurved and stepped back at eye 2. Side walls strongly convex. Groove narrow and slightly recurved. Thorax well rounded at sides and terminated with almost square end of $\frac{2}{3}$ full width. Rim strong.

(*b*) Top of caput flat. Groove narrow and shallow. Thorax rises slightly behind it and then falls with strongly convex slope to end with strong concave rim.

Text-figure 10.



Myrmarachne biseratensis, sp. n., ♂.

a. Profile. *b.* Palpus. *c.* Sternum &c.

Dark, especially on caput, but eye-frame traceable, black.

Eyes.—1st row straight by summits, 1 . 1 very close, 1 . 2 close. 2 = $\frac{1}{3}$ 1, 3 slightly nearer 2 than 4 and on upper tangent, 4 slightly > 2. Eye square broader than long, 4 . 4 very slightly > 2 2 and about = 4-rim.

Falces = cephalothorax, length = 5 breadth, straight inner edge, outer slightly convex, broadest at ⅔. End concavely truncated and facing slightly outwards so as to make inner end rather pointed but not projecting. Upper edge at first flat, then rises with strong convexity so as to make it much higher at ⅔. Lower edge at first flat, then a convex step downward and flat to end. Lighter colour and stippled.

Unguis not as long as falx, reaching only to end of flat, doubly curved and with distinct prominence (not, however, to be called a branch) at ½. Groove rather distinct, but not deep. Upper teeth 4, 1 at base of unguis strong but very close and liable to be missed, perhaps rather a process at end of falx; the other 3 equally spaced along 2nd basal quarter. Lower teeth 15, evenly spaced, stronger than usual and, at any rate, some of them alternate in size.

Maxillæ.—Shape as *maxillosa*. Scopula very strong, but grey. Outer portion dark, inner equally wide, light.

Labium.—Proportions and colouring as *maxillosa*. Slightly constricted in middle, parallel sides, and apex concave with dark scopula.

Palpi.—Spring from near base of maxilla. Tr > width maxilla, dark sides, light below; f = 2 tr, dark, with grey hairs slightly curved; p < tr, parallel sides. Ti nearly = f, short process at fore, outer, lower corner, widens apically. Ta a little > ½ ti, oblong. Both ti and ta are hairy, with a strong fringe on inner edge. Ti = ta below. Fovea occupies a little more than basal half of ta, and is surrounded by a dark hairy edge. A spine springs from basal inner edge, coils up inner side round 1½ times and terminates in a fine point facing forwards. Style long and looped backwards from bulb in front.

Legs.—4 . 1 . 3 . 2, with differences more or less equal.

1st. c ovate, lighter than falces.
tr < width c, lighter with dark at sides.
f clubbed, dark, long.
p curved = ⅓ ti, no spines, dark.
ti dark, spines difficult, but apparently there have been 5 pairs all weak, of which first two are basal and medial and last three fairly close at apical end.
m = ⅔ ti, dark, 2 spine pairs much stronger than ti.
ta = ½ m, dark.

2nd. c a little longer than broad.
tr short, dark sides.
f dark, more clubbed than f_1.
p = ½ ti, curved, dark at apex above and sides, no spines.
ti dark at sides, 2 spine pairs.
m nearly = ½ ti, light except for dark marks on sides at base, 2 spine pairs.
ta = ¼ m, light.
The tibial spines of 2nd are very strong compared with those of 1st.

3rd. c, tr, f, dark and all a little longer and stronger than 2nd.
p $= \frac{1}{3}$ ti, both dark.
m nearly = ti, light.
ta $= \frac{1}{4}$ m, light.
4th. c $< c_1$, stout, length $= 1\frac{1}{2}$ greatest breadth, dark.
tr > c, much longest tr, light with dark sides.
f long, clubbed, dark.
p $= \frac{1}{5}$ ti, dark.
tr dark, cylindrical.
m = ti nearly.
ta $= \frac{1}{5}$ m, light.

Sternum.—Truncated between $c_{1\,.\,1}$, which are about $\frac{1}{3}$ width apart, swells out between other c, especially between $c_{2\,.\,3}$, which are only a little wider than the others, tapers with undulating sides to a sharp but rather short point in front of $c_{4\,.\,4}$, which are in sub-contact.

PEDICEL.—Short but distinctly visible from above. j_1 as seen from above distinctly longer than j_2. 1st upper lorum decreases backwards, where it is procurved, much broader than 2nd. Whole length of pedicel < 2 greatest width. It is received into a short socket projecting from opisthosoma.

OPISTHOSOMA.—Egg-shaped, widest about $\frac{2}{3}$. Above general colour dark greenish brown, below somewhat light, the front of epigastric fold yellowish, corneous, behind a longitudinal lighter band to spinners, widest at fore end, whence it reduces suddenly and then parallel.

Spinners.—1st stout, subconical. 2nd longest, lightest, thinnest, cylindrical. 3rd very slightly stouter, shorter, and darker than 2nd. All spring from projections of abdomen and are 2-jointed, with 2nd joint very short.

Anus on a strong tubercle.

SHORT DESCRIPTION.

Prosoma very slightly > opisthosoma. Caput = thorax. Groove narrow and shallow. Thorax well rounded behind and only slightly lower than caput. Sides of caput convex. Falces = cephalothorax, subparallel, on side view much thicker towards apex. Unguis slightly < paturon and with distinct prominence. Teeth, upper 4 all in basal half and are close to base of unguis; lower 15 partly alternate in size.

Palpi.—Tibia = tarsus. Fovea only occupies basal half of tarsus, a spine springing from basal inner edge coils $1\frac{1}{2}$ round and terminates pointing forward.

Legs 4 . 1 . 3 . 2, with moderately equal intervals. Spines of ti_1 noticeably weak but probably 5 pairs, m_1 2 pairs, tr_2 2 pairs, very strong for 2nd leg, m_2 2 pairs. tr_1 and tr_4 are distinctly lighter than other joints.

Sternum rather broad. 2nd and 3rd coxæ only a very little further apart than the others.

Pedicel shortish.

Opisthosoma, as whole spider, rather squat.

Note.—The description is based on a single ♂ from Biserat, length 6·2 mm. Its general shape reminds one of *M. maxillosa* ♀.

The following are measurements of the legs:—

1......	p+tr 1·3,	f 1·9,	p+ti 3·0,	m+ta 1·9	=8·1
2......	„ 1·0,	„ 1·6,	„ 1·9,	„ 1·2	=5·7
3......	„ 1·1,	„ 1·6,	„ 2·0,	„ 2·0	=6·7
4......	„ 1·3,	„ 2·4,	„ 2·6,	„ 2·6	=8·9

This spider was found in company with ants nos. 2 and 17. It is very probably a ♂ of *M. maxillosa*, which it strongly resembles in general shape and colouring, all its features being those of *maxillosa* exaggerated even to the falces. The only distinct difference is in the spine pairs. It is the only ♂ in the collection the least like the ♀ *maxillosa*, which is so common, and I should not have hesitated to claim it as the ♂ did it not differ so strongly as regards teeth and tibial spines from Thorell's ♂ *M.* (*Toxeus*) *maxillosa*. It was found in company with ♂ *Epidius longipalpis* described above.

♂. MYRMARACHNE GEDONGENSIS, sp. n. (Text-fig. 11.)

PROSOMA. - Length a little > opisthosoma = p_4+t_1. Caput > thorax. Front wall slightly projecting in centre and stepped back to eyes 2. Side walls straight, very slightly approaching backward. Back wall nearly straight. Groove not marked from above, but walls of thorax going on nearly straight with slight convex and then concave slope to rear, which is cut nearly square and about $\frac{1}{2}$ greatest width and strongly rimmed.

On side view caput flat but convex near eye 4, back slope steep, groove about $\frac{2}{3}$ caput, the broad thorax rises convexly to $\frac{1}{3}$ and then falls gradually convexly and concavely to rim, which is shallow.

Eyes.—1st row straight by summits, 1 . 1 in contact; 2 subcontact with 1 and a little stepped back, = $\frac{1}{3}$ 1. Eye square broader than long, parallel. 3 slightly nearer 2 than 4. 4 > 2. 4 . 4 = 4-rim.

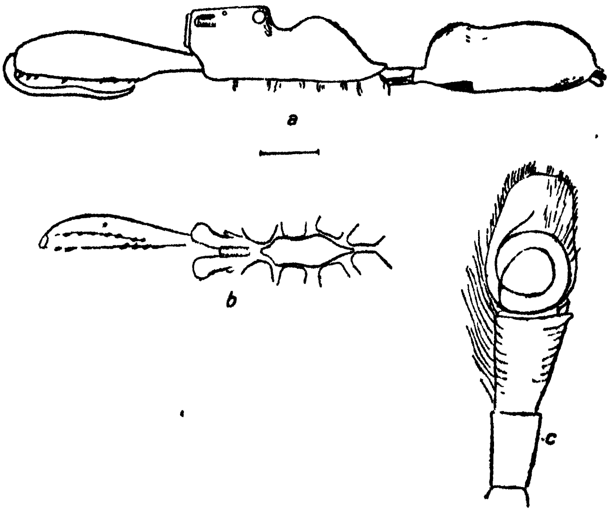
Falces.—Length = cephalothorax, breadth = $\frac{1}{4}$ length. From above inner edge straight, outer convex, being widest at $\frac{3}{5}$, end cut square. From side slightly concave above, below a double flat step to $\frac{1}{8}$, then straight to end. Lighter colour and granulated. Unguis > $\frac{2}{3}$ paturon, bisinuate, with basal curve nearly flat, simple. Teeth, upper 6 or 7, of which 1st is very strong at root of unguis and pointing forward, 2 or 3 close to it, and remaining teeth at other end of groove and wide. Lower 7 to 9, subequally spaced and decreasing from base to apex of unguis. Groove well marked.

Maxillæ.—As *turriformis*, but outer corner sharp. Length = c_1.

Labium.—As *turriformis*, but base is very distinct, terminating in a short point well in front of sternum. Apex very slightly concave and scopula light.

Palpi.—Spring from near base of maxilla. Tr > width maxilla; f slightly > tr, < c_1, rather strongly curved; p slightly < tr, very slightly widening forward. Ti a little longer and much stronger than patella, much wider apically and with strong pointed outer, lower, apical process. Fringe of long dark hairs on inner edge. Ta broader at base, cut off square at apex, slightly longer than ti, hairy. Fovea occupies about ⅔. A spine springs from outer base of organs and passes round on inner edge of fovea, terminating with a slender forward point at about middle of apex.

Text-figure 11.



Myrmarachne gedongensis, sp. n., ♂.

a. Profile. *b.* Sternum &c. *c.* Palpus.

Legs.—4 . 1 . 3 . 2, with considerable differences.

1st. c longest, length = 2½ breadth, parallel or very slightly tapering, light, slightly dark at base and sides.
tr long, nearly ½ c.
f slightly clubbed at base, dark.
p = ½ ti, 1 pair spines, light.
ti, spines from 6 and 7 to 8 and 9, strong, and last 4 or 5 all terminating at end of joint, light.
m, 2 spine pairs, of which 1st very long and both terminate about middle of ta, darker.
ta < ½ m, dark.

2nd. c very short and gibbous, dark.
tr very short, light.
f less clubbed than f_1, light with dark sides.
$p = \frac{1}{3}$ ti, no spines.
ti, 3 or 4 spine pairs.
m, 2 spine pairs, all spines are very strong for 2nd leg.
ta $< \frac{1}{2}$ ti, light.
3rd. c & tr larger than c_2 and tr_2.
f dark, clubbed slightly.
$p = \frac{1}{3}$ ti.
ti cylindrical.
m > ti, ta $= \frac{1}{4}$ m.
4th. c a little $> c_3$, but much $< c_1$, slightly tapering.
tr much longest, > c, $< c_1$, cylindrical, light with dark sides.
f long, slightly clubbed, dark.
$p = \frac{1}{3}$ ti, slightly curved, dark.
ti cylindrical, dark.
m slightly < ti, darkest at end sides.
ta $= \frac{1}{3}$ m.
Colour contrasts of legs very slight.

Sternum.—Short-pointed between $c_{1\ 1}$, which are about $\frac{1}{3}$ their width apart, and between $c_{1\ 2}$, sharp-pointed between $c_{2\ .\ 3}$, which are only very slightly further apart than the others, and thence undulating to a not very long point in front of $c_{4\ 4}$, which are not quite in contact.

PEDICEL.—Shortish, $j_1 > j_2$, 1st lorum parallel-sided and concave behind, slightly wider than 2nd. Below lorum is continued forward by a narrow projection towards sternum, but not to meet it.

OPISTHOSOMA. Ovate, thickest at middle, very slight constriction at $\frac{1}{4}$, which is marked by slight oblique white lines at sides. General colour brown-green. Below, central longitudinal wide lighter marking from epigastric fold to spinners, slightly constricted near front. Epigastric fold procurved, with area in front yellow-brown and corneous.

Spinners.—As *biseratensis.*

Anus.—Distinctly protuberant, with two joints.

SHORT DESCRIPTION.

Prosoma very slightly > opisthosoma $= p_1 + t_4$. Caput > thorax. Groove and thorax moderate.

Falces = cephalothorax, unguis $> \frac{2}{3}$ paturon. Upper teeth 6 or 7, of which 1 very strong at root of unguis and 2 or 3 adjacent, remainder distantly spaced at other end. Lower teeth 7 to 9.

Palpi.—Trochanter rather long, tibial process strong Ta distinctly > ti. Fovea occupies more than half tarsus: organs have spine springing from outer base and passing round inner edge to terminate in fine point in front.

Legs 4 . 1 . 3 . 2, considerable intervals. Spines of ti_1 from 6 . 7

to 8.9, p_1 1 pair, tr_2 3 or 4 pairs. c_2 and tr_4 much larger than the others.

Pedicel shortish, with long and narrow point reaching forward between $c_{4.4}$ towards but not reaching sternum.

Opisthosoma ovate, with faint attempt at constriction at ¼ and slight white lateral markings thereat.

Note.—Description is based on two males of lengths 5·9 and 7·0 mm. from Bukit Besar and Gedong.

The following dimensions are from the 7·0 mm. specimen:—

Prosoma 3·2. Opisthosoma 3·2.

Legs 1	c+ti 1·5,	f 2·9,	p+ti 3·4,	m+ta 1·9	= 9·7
2	„ 1·0,	„ 1·6,	„ 2·0,	„ 1·6	= 6·2
3	„ 1·0,	„ 2·1,	„ 2·3,	„ 2·3	= 7·7
4	„ 1·8,	„ 3·2,	„ 3·2,	„ 3·0	= 11·2

One of the specimens was accompanied by ant no. 6.

Agorius Thor.

Thorell, St. Rag. Mal. 1877, p. 216; E. Simon, Hist. Nat. Araign. ii. p. 537 (1901).

♀. Agorius gracilipes Thor. (Text-fig. 12.)

Prosoma. *Cephalothorax.*—(*a*) Front truncated with very slightly recurved edge beyond front, of which eyes 1.1 project slightly and 2.2 less. Sides straight and very slightly approaching to ⅔ thorax, where they commence to approach more rapidly with slightly concave edge. Hind end broadly truncated, somewhat concave. Hind end of caput is slightly indented and thoracic grooves indicated. Separation of thorax from caput clear, but groove not deep and no constriction at sides. Edge is rather dark at end and ends of sides of thorax, but does not appear as a distinct rim. General colour light reddish yellow except for black eye-frame on front and sides.

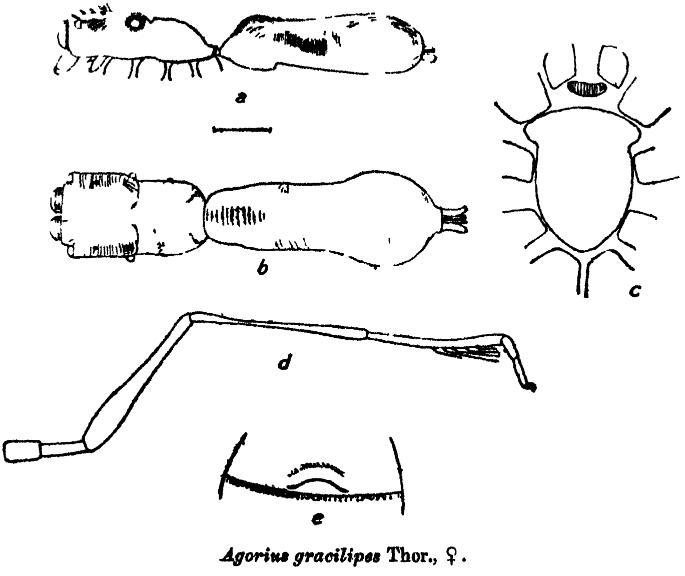
(*b*) Eyes 1.1 project strongly like the buffers of a waggon, 2.2 the same slightly above and behind, clypeus is almost negligible and underhung, and these together form the front wall. Top of caput distinctly convex from eyes 2 to 4, and again over 4, being about ⅔ as high as long. Dark eye-frame reaches only to about bottom of eyes 2.4 and is almost broken just in front of 4. Groove slopes at 45° from above 4, and is only about as deep as middle of 4. Thorax rises convexly to about ⅓ and falls concavely for last ⅔, end being slightly turned up but not really rimmed. Thorax as high as caput.

(*c*) Clypeus very slight, smooth, procurved. Short grey hairs around eyes 1.1, and dark hairs longer on clypeus and above eyes. Top of caput flat or very slightly convex. Sides slope inwards very slightly and convexly from below eye 2, which projects strongly and forms angle.

Eyes.—Clypeus concave, $< \frac{1}{3}$ eye 2. 1st row strongly recurved, top of 1 being level with mid 2. $2 = \frac{1}{2}$ 1, all 1st row in subcontact. Eye-quadrangle broader than long and very slightly narrower behind. $4 < 2$. 3 distinctly nearer 2 than 4 and slightly inside the upper 2.4 tangent. 2 are on attached fore and aft projections. 4 project strongly outwards.

Falces.—Almost concealed from above, nearly horizontal, length only a little > diameter eye 1. Moderately broad and rounded on top and side views. From below slightly tapering, with a few dark hairs in centre. Angle well rounded. Groove distinct. Ungues slope inwards. Upper teeth 1 large at angle, 1 small below. Lower, 1 large about mid-unguis, but slightly less than large upper. There appears to be a small tooth at end of paturon behind root of unguis. Scopula of long light hairs on outer margin.

Text-figure 12.



Agorius gracilipes Thor., ♀.

a. Profile. *b.* From above. *c.* Sternum &c. *d.* First leg. *e.* Epigyne.

Maxillæ.—Much shorter than *Myrmarachne*, $< c_1$, rounded and expanded at end and slightly spreading. Serrula at outer edge and end; dark scopula at truncation, which is short and nearly transverse, a few hairs along outer edge.

Labium.—Very short, broader than long. White edge with scanty dark scopula.

Palpi.—Spring from about half maxilla. Tr short, < width of maxilla, and 2nd division small; f a little > maxilla, slender, cylindrical, straight or very slightly curved, with slight dusky shading at sides; $p = \frac{1}{2} f > tr$, slightly wider at apex than base; $ti < p$ but much thicker and more hairy; $ta > ti$, joint between the two somewhat curved. p, ti, and ta all have hairy fringes on both sides, increasing from very slight at p to strong on ta; on back they are greenish. Ta and ti are slightly flattened, but not nearly to the same extent as *Myrmarachne*, and the joint between them is quite distinct.

Legs.—4 = 1–3–2, but measurements not good and either 4 or 1 may be the longer.

1st. c length $= 2\frac{1}{2}$ width = nearly width of sternum, light, cylindrical.
- $tr = 1\frac{1}{2}$ c, cylindrical, a little darker.
- f long, clubbed at base, slender, darker, and very dark at one side below.
- $p =$ sternum $> f$, slenderer, dark below, light at end; this extraordinarily long patella is the most characteristic feature of the genus.
- $ti < p$, with angle half way, after which it becomes stouter and bends outwards. 5 spine pairs beginning at angle, all are strong, 1st reaches more than half way to apex, and remainder all end level with apex.
- m very short, $< tr$. 2 spine pairs, 1st very strong, springing from middle and reaching well beyond 2nd, which springs from end and reaches to mid ta. Joint about as stout as end of ti.
- $ta = 1\frac{1}{2}$ m, lighter and slighter.

2nd. $c < c_1$, white.
- $tr = \frac{1}{2}$ c, light, with black blotch at lower apex.
- f very slightly if at all clubbed at base, the black of tr is carried up as a strong black line below or rather to the side of whole length of joint.
- $p = \frac{1}{3} f$, slightly curved and stouter at apex.
- $ti = 2$ p, slender.
- $m = \frac{2}{3}$ ti; ta missing.

3rd. c a little shorter and stouter than c_1.
- $tr = \frac{1}{2}$ c.
- f very slightly, if at all, clubbed at base, slightly clouded at sides.
- p, ti, m as 2, but slightly stouter.
- $ta = \frac{1}{2}$ m.

4th. c very strong, slightly broader at base than apex, longer than c_1, stouter than c_3.
- $tr > c$ and $> tr_1$.
- Remaining joints as 3.

All tarsi have claw-tufts and two pectinate claws.

Sternum.—Shield-shaped, with expanded ears at front. $c_{1.1}$ are wide apart, springing from opposite the ears; $c_{1.2}$ is broad, nearly = breadth c_2, $c_2 c_3$ less, $c_3 c_4$ least, $c_{4.4}$ in contact, sternum terminating in a short point in front of them. The legs appear to spring from a separate chitinous plate lying between dorsal shield and sternum, and produced into a long socket to take c_1.

PEDICEL.—Very short; it is just possible to see its point of entrance below dorsal concavity at top, but it cannot be seen at all from below.

OPISTHOSOMA.—*Abdomen* = $1\frac{1}{2}$ cephalothorax, subcylindrical, width = height = < $\frac{1}{2}$ length. Rounded in front and behind, being slightly wider behind, slight constriction half way. On side view constriction at $\frac{1}{3}$. Ground-colour greenish brown above formed by a light ground dark-lined, two small white blotches at constriction in a transverse line, followed by a large central white blotch. From the small blotches white lines slope downwards and backwards across the sides, getting wider as they proceed and connecting with white ground-colour which prevails below behind epigastric fold to spinners. Spiracular plates chitinous, yellow-brown, and so wide apart as to be hardly visible from below and noticeable from the side. Between them a strip of same colour, but I think not chitinous. Epigastric fold is strongly procurved, but not well marked.

Epigyne.—A small white semicircular pit edged with dark red and with a pair of dark markings forming arcs of a semicircle outside. Not very marked, but clearer than in *Myrmarachne.*

Spinners. As seen from below, spring from a very distinct half-socket. the edges of which, however, are not continued round. All spring from separate sockets inside the above and are 2-jointed, the basal joint being very long, the second very minute. 1st. Very slightly tapering, about twice as long as broad, brown-yellow. 2nd. Equal length, lightest, slenderest. 3rd. Dark as 1st at base, light as 2nd at apex, intermediate in stoutness but nearest 2nd, longest.

Note.—The description is from a single ♀ found at Bukit Besar, 2500 ft. altitude, in cavity under the bark of a rotten sapling.

The following are measurements:—

Total length 7·0 mm.

Prosoma ...... 2·7 long × 1·6 wide × 1·4 high.
Opisthosoma... 4·6 ,, × 2·0 ,, × 2·0 ,,

Legs.

1......	c+tr 1·4,	f 2·6,	p 2·8,	ti 2·0,	m+ta 1·0	=9·8
2......	c+tr+f 2·4,		p+ti 2·0,		,, 1·0	=5·4
3......	,, 2·5,		,, 2·0,		,, 2·0	=6·5
4......	c+tr 1·5,	f 2·3,	,, 3·0,		,, 3·0	=9·8

The legs were damaged and impossible to measure with accuracy, so that either 1 or 4 may be the longest.

Ants accompanying, none.

24. The Structure of the Orbito-temporal Region of the Skull of *Lemur*. By F. Wood Jones, M.B., D.Sc., F.Z.S.

[Received and Read November 20, 1917.]

(Text-figures 1–5.)

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Structure and Morphology .... pp. 323–329

The question of the structure of the orbito-temporal region of the Lemurs is one that has by now accumulated a very bulky literature; and this fact is, in itself, almost a guarantee that some difficulty and uncertainty is attached to interpreting appearances which are open to ordinary inspection in the skulls of animals that are neither particularly minute nor particularly rare. The uncertainty is at once made apparent by a study of this literature; for very different accounts are given of the elements which enter into the composition of this limited portion of the skull. But another factor may be detected, and this is a rather more subtle one than any mere difficulty in recognising ill-marked suture-lines. It is obvious that some have wished to see an ordering of the bones upon lines indicative of a Primate kinship, while some have neither looked for, nor expected, any indications of such affinity.

The observations recorded here were made upon two full-term fœtuses—the one of *Lemur catta*, and the other a hybrid between *L. albifrons* ♂ and *L. melanocephala* ♀, both born in the Gardens of this Society. Beyond the limits of these two representatives of the genus *Lemur* the present inquiry is not extended so far as the study of fœtal material is concerned. The question that has been an outstanding one for now nearly a century is the presence or absence in the orbital wall of an "os planum" or "planum orbitale" of the ethmoid bone. If we turn to a recent work ('Morphology and Anthropology,' by Dr. W. L. H. Duckworth, 1915), we find the following as a description of this region in *Lemur*:—"On the inner orbital wall, the frontal and maxillary bones join along a suture for a distance of about 5 mm., and thus widely separate the ethmoidal from the lachrymal bone" (p. 73). The condition here described depicts a phase only separated by degree from that prevailing in the Anthropoidea, and the description leads one to suppose that the lachrymal in the fore part of the orbit is separated from the os planum of the ethmoid in the hind part of the orbit by the meeting of the frontal and maxilla from above and below over the intervening interval of 5 mm. The figure that accompanies this description lacks definition in some of its index lines; but apparently it bears out this diagnosis of the disposition of the elements.

By far the most critical and exhaustive account of this region is that contributed by C. I. Forsyth Major to the 'Proceedings' of this Society on Feb. 19th and March 19th, 1901. Here the os planum of the ethmoid is described and figured in an extensive series of skulls of Lemuroidea.

In his earlier paper (p. 131) the author says:—"Amongst the Malagasy Lemurs a fairly large os planum" (of the ethmoid) "is present in all the species of *Microcebus*. In the other genera the planum becomes fused with the palatal at a very early date. A distinct small os planum is often visible in young specimens of *Hapalolemur*, *Chirogale*, *Lepidolemur*, and *Avahis*, and sometimes in *Lemur*." But in the later paper the statements concerning *Lemur* are rather more extended, for at p. 258 the following statement occurs:—"The lateral part" (of the os planum of the ethmoid) "has become united with the palatal at a very early stage; a remnant of the suture with the latter bone is seen in the adult at its antero-medial extremity; in exceptional cases, *e. g.*, in *Lemur catta* and young specimens of *Lepidolemur*, the planum remains completely or almost completely distinct from the palatal." A figure of the orbito temporal region of *L. catta* leaves no doubt as to the author's meaning. The os planum of the ethmoid is diagnosed as intervening between the lachrymal in front and the palatal behind.

Here, therefore, we have an admission of the same bony elements as are described by Duckworth; but their arrangement is depicted in a strangely different order, for whereas Forsyth Major makes the ethmoid coterminous with the lachrymal anteriorly, Duckworth separates it from this element by a meeting of frontal and maxilla over an interval of 5 mm.

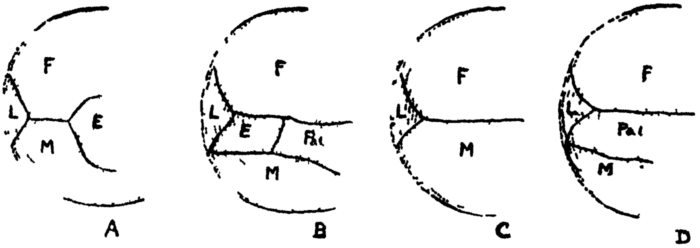
Going somewhat further back in the literature of the subject, we find a series of authors denying the presence of an os planum ethmoidale in the orbit of the Lemurs. It was indeed to refute the findings of these authors that Forsyth Major published the papers from which the above quotations have been made.

The French zoologists, for the most part, have denied the presence of this element, and probably in this they have been guided or assisted by their intuitive discrimination which sees little but superficial resemblance between the Malagasy Lemurs and the Anthropoidea. Cuvier declared that the os planum of the ethmoid was in the Lemurs altogether enveloped by the frontal and the palatine, and therefore did not appear as an element in the wall of the orbit.

MM. Grandidier and Alphonse Milne Edwards regarded the os planum as being overlain by the frontal which therefore came in contact directly with the maxilla. Obviously Flower came to the same conclusion, for he says, "The os planum of the ethmoturbinal does not enter into the inner wall of the orbit, but is shut out by the maxilla."

In this cursory survey of the literature we have therefore four distinct diagnoses of the elements entering into the formation of this region in the Lemurs. The first two (those of Duckworth and Forsyth Major) admit the presence of the os planum of the ethmoid, but differ widely as to the arrangement of the different elements. The second two (those of Grandidier & Milne Edwards and Flower, and of Cuvier) exclude the presence of an os planum of the ethmoid, but differ as to the elements which overlie and exclude this bone. The position will be simplified by reducing the four diagnoses to diagrams in which cognisance is taken only of the elements which are in dispute (see text fig. 1).

Text figure 1.



Diagrams to represent the diagnosis of the elements entering into the formation of the orbital wall of *Lemur*.

F = frontal *L* = lachrymal *E* = ethmoid *Pal* = palatal *M* = maxilla

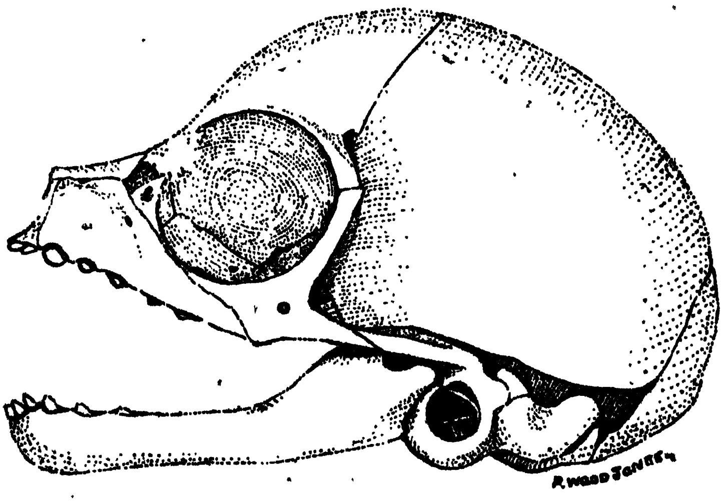
A. According to Duckworth. **B.** According to Forsyth Major.
C. According to MM. Grandidier & Milne Edwards, and also Flower.
D. According to Cuvier.

It is often impossible to comment upon the work of previous authors unless their written statements can be correlated with the specimens from which the descriptions were taken. Individual variation may play a large part in discordant description, and for this reason it behoves every author to specify the material from which his descriptions are drawn. In only one case (that of Dr. Forsyth Major) is this condition fulfilled. In every case in which he describes and figures a specimen he notes its number in the National Collection preserved in the British Museum.

It was therefore the diagnosis of Forsyth Major that I first attempted to verify. In 1914, by the kind permission of Mr. Oldfield Thomas, I examined the actual specimens described in the paper of 1901. The conclusion I arrived at was that the problem was one of exceeding difficulty when confined, as it was in this case, to the skulls of adult Lemurs. But I also gathered the impression that the interpretation of presumed suture-lines described and figured by the various authors was, in many cases, open to grave doubts, and that the so-called "os planum" was not in all cases the same element (see figs. 65 & 66, p. 258, *op. cit.*, of specimens 97.9.1.18 and 97.4.6.1). A glance at these two figures, and more especially an inspection of the actual specimens, will convince anyone that the bone labelled "pl" in the two figures is not the same element in the two specimens. The same criticism holds good throughout the paper. From specimen to specimen the irregularity of the apparent suture-lines increases, and the only conclusion at which it was possible to arrive was that the question was incapable of solution by an examination of adult specimens; since it was certainly essential to see the simplified condition in the fœtal or new-born individual.

It was not until the present year (1917) that two fœtal Lemurs, preserved by Mr. R. I. Pocock, were placed unreservedly in my hands, and I had the opportunity of examining the structure of the orbito-temporal region before any of the post-natal, secondary changes had set in. Of the two specimens that of *L. catta* is the less highly ossified, and the constituent bones of the crania wall are seen with diagrammatic clearness (see text-fig. 2). The condition of the orbito-temporal region is shown in text-figure 3. The orbital plate of the frontal takes a very large share in the formation of the orbital wall; it meets the nasal and lachrymal in front, but at this stage it is separated from the frontal process of the maxilla by an unossified interval. Behind it meets the parietal at the coronary suture, and below that it meets the anterior edge of the very small orbito-sphenoid. Along the lower border of the orbital plate of the frontal runs an elongated bone shaped somewhat like a ploughshare. This bone articulates in

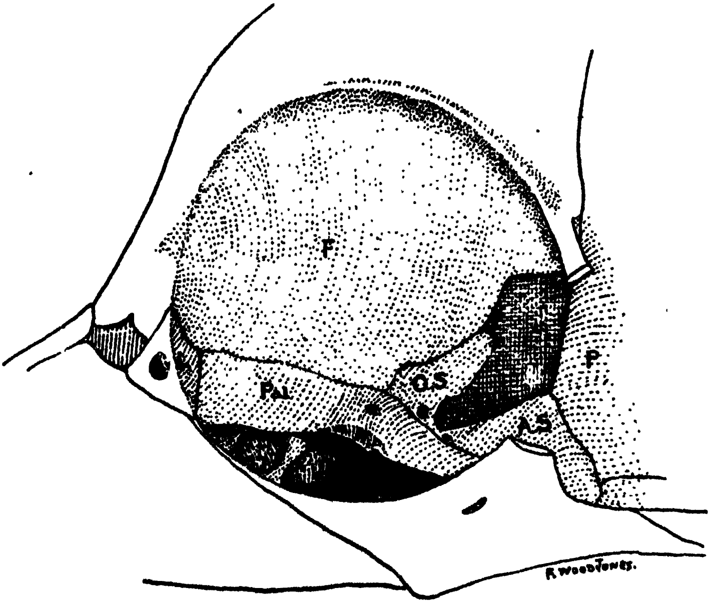
Text-figure 2.



The skull of a fœtal specimen of *Lemur catta*. Actual length 39 mm.

front with the lachrymal, and behind the orbital plate of the frontal it is in contact with the orbito-sphenoid and alisphenoid. Below, the greater portion of its length is free, but, in front, the maxillary, which is very small and only partially ossified, meets its lower border. This long bone is the orbital process of the palate, and at about its mid-point it is perforated by two foramina, presumably the naso-palatine canals.

Text-figure 3.



The orbito-temporal region in the fœtal *L. catta*.

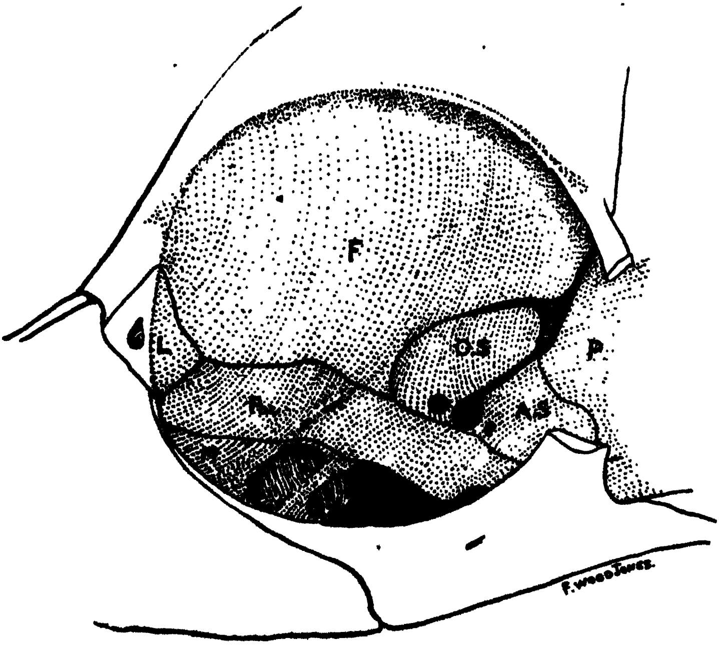
L. = lachrymal. *F.* = frontal. *Pal.* = palatine. *O.S.* = orbito-sphenoid. *A.S.* = Alisphenoid. *P.* = parietal. *M.* = maxilla.

In the other specimen, which is rather more advanced in ossification, the condition is similar in all essential points. The sphenoid and the maxilla are somewhat further ossified; but the most interesting feature is a slight bending of the axis of the orbital plate of the palate at the site of the naso-palatine foramina (see text-fig. 4).

In the adult of *Lemur catta* the picture has changed very remarkably, for the portion of the palate anterior to the naso-palatine canals has become inflated with an air-sinus; and it has been somewhat bent back over the uninflated plate posterior to these canals (see text-fig. 5).

Reference to Forsyth Major's figures of the orbit of *Lemur* *catta* B.M. 59*c* (figs. 61 & 62, p. 256) will show that it is this anterior inflated portion of the palate which is diagnosed as the os planum of the ethmoid. Concerning the inflation of this part of the orbital wall Forsyth Major says: "It" (the so-called os planum of the ethmoid) "always forms the roof of a pneumatic cavity, which often (*L. catta*, *L. macaco*, *L. varius*) is but an appendix of the maxillary sinus. The anterior portion of the palatal also participates, as a rule, in the formation of this pneumatic cavity, by forming its posterior cul-de-sac." As a matter of fact, it is this variability of the posterior extension of the inflated area that produces the variability of the presumed suture-line. The bones of the orbital wall are particularly thin and transparent in the Lemurs, and in adult examples the septa between air-chambers may be far more conspicuous than actual suture-lines. This condition is carried to extremes in old specimens of some types, such as *Galago*, in which the whole of the orbital wall (and of other regions of the skull) has the appearance of cracked ice, each crack corresponding to a bounding wall of a small sinus, and the whole creating such a meshwork of lines

Text-figure 4.

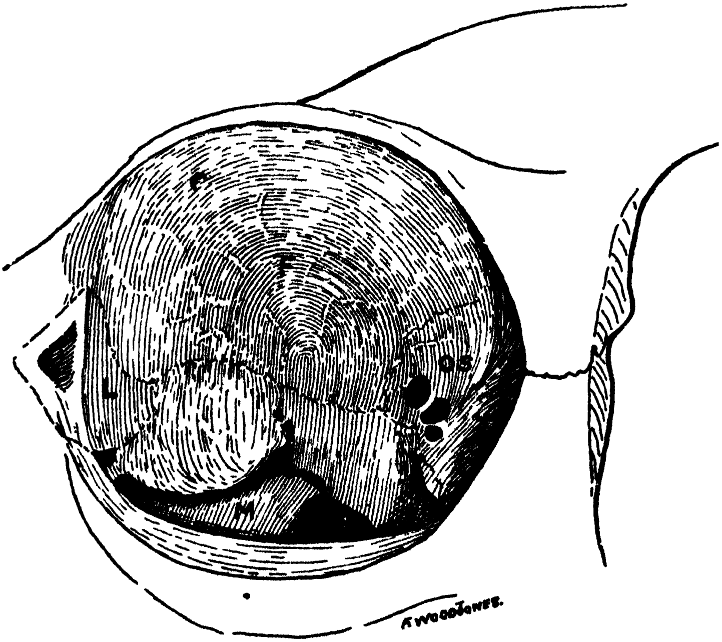


Orbito-temporal region in the fœtal skull of *L. albifrons* × *L. melanocephala*. Length 41 mm. Lettering as in text-fig. 3.

that the determining of sutures separating different bony elements becomes a hopeless task.

More than this, synostosis of the different elements is effected at a comparatively early stage in the Lemurs.

Text figure 5.



Orbit of an adult ♀ *L. catta*. Lettering as in text-figs. 3 & 4.

The palate-bone is not indicated by lettering and is apparently subdivided into two portions by the inflation of its anterior extremity.

Before the comparison of different species, or the much more important contrasting of the Malagasy and non-Malagasy forms, can be undertaken, an examination must be made of fœtal and young stages, and until that is done the question of the variability of this region must remain an open one. But, for the genus *Lemur*, the two fœtal examples described here appear to indicate clearly that the os planum of the ethmoid is lacking from the orbital wall, and that a very common mammalian, but definitely non-primate, arrangement of the bony elements is present in this region.

EXHIBITIONS AND NOTICES.

October 23rd, 1917.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President, in the Chair.

The SECRETARY read the following Report on the Additions made to the Society's Menagerie during the months of May, June, July, August, and September, 1917:—

MAY.

The registered additions to the Society's Menagerie during the month of May were 241 in number. Of these 125 were acquired by presentation, 46 were received on deposit, 60 by purchase, 1 in exchange, and 9 were born in the Gardens.

The number of departures during the same period, by death and removals, was 135.

Amongst the additions special attention may be directed to:—

1 Grison (*Grison furax*), 1 Cordovan Skunk (*Conepatus proteus*), new to the Collection, and 1 Viscacha (*Lagostomus trichodactylus*), from Cordova, in the Argentine, presented by W. A. Smithers, C.M.Z.S., on May 4th.

4 Ostriches (*Struthio camelus*), from the Northern Territories, West Africa, presented by Capt. C. H. Armitage, C.M.G., D.S.O., F.L.S., on May 31st.

2 Burmeister's Cariamas (*Chunga burmeisteri*) and 1 Black Vulture (*Cathartes atratus*), from Cordova, Argentina, presented by W. A. Smithers, C.M.Z.S., on May 4th.

JUNE.

The registered additions to the Society's Menagerie during the month of June were 168 in number. Of these 54 were acquired by presentation, 54 were received on deposit, 42 in exchange, and 18 were born in the Gardens.

The number of departures during the same period, by death and removals, was 100.

Amongst the additions special attention may be directed to:—

1 Hensel's Cat (*Felis pardinoides*), new to the Collection, from Bahia, presented by W. A. Smithers, C.M.Z.S., on June 11th.

1 Eland (*Taurotragus oryx*), born in the Menagerie on June 21st.

A collection of Reptiles, including 3 Anacondas (*Eunectes murinus*), 1 Thick-necked Boa (*Epicrates cenchris*), and 1 Cooke's

Tree-Boa (*Corallus cookii*), from Trinidad; 1 Antillean Boa (*Boa diviniloqua*), from Dominica; 2 Black Cribos (*Oxyrhopus clœlia*), 3 Rat tailed Snakes (*Lachesis lanceolatus*), from Trinidad; and 1 Terrific Rattlesnake (*Crotalus terrificus*), from British Guiana, deposited on June 21st.

JULY.

The registered additions to the Society's Menagerie during the month of July were 72 in number. Of these 27 were acquired by presentation, 7 were received on deposit, 11 by purchase, and 27 were born in the Gardens.

The number of departures during the same period, by death and removals, was 75.

Amongst the additions special attention may be directed to:—

1 White-bearded Gnu (*Connochœtes albojubatus*), born in the Menagerie on July 12th.

1 Barbary Sheep (*Ammotragus lervia*), born in the Menagerie on July 19th.

1 Hyacinthine Macaw (*Anodorhynchus hyacinthinus*), from S. America, deposited on July 21st.

1 Diamond Python (*Python spilotes*), from Australia, purchased on July 2nd.

AUGUST.

The registered additions to the Society's Menagerie during the month of August were 80 in number. Of these 22 were acquired by presentation, 14 were received on deposit, 4 by purchase, and 40 were born in the Gardens.

The number of departures during the same period, by death and removals, was 85.

Amongst the additions special attention may be directed to:—

1 Ocelot (*Felis pardalis*) ♂, from South America, and 1 Serval (*Felis serval*), from Africa, presented by Sir Claud Alexander, Bt., on August 30th.

1 Brindled Gnu (*Gorgon taurinus*) ♂, from South Africa, and 1 Anoa (*Anoa depressicornis*) ♂, from Celebes, deposited on August 30th.

1 Three-streaked Skink (*Mabuia trivittata*) and 1 Small-scaled Zonure (*Zonurus polyzonus*), the latter new to the Collection, from South Africa, presented by Dr. R. Broom.

SEPTEMBER.

The registered additions to the Society's Menagerie during the month of September were 83 in number. Of these 62 were acquired by presentation, 2 were received on deposit, and 19 were born in the Gardens.

The number of departures during the same period, by death and removals, was 69.

Amongst the additions special attention may be directed to:—

3 Coypus (*Myocastor coypus*), from South America, presented by Sir Edmund G. Loder, Bt., F.Z.S., on September 20th.

2 Yucatan Blue Jays (*Cissolopha yucatanica*), from Yucatan, presented by Guy Falkner, F.Z.S., on September 29th.

1 White-breasted Kingfisher (*Halcyon smyrnensis*), from Ceylon, presented by J. R. Lee Booker on September 1st.

6 Anacondas (*Eunectes murinus*), born in the Menagerie on September 19th.

Effect of Captivity on the Cranial Form of the Lion.

Prof. F. Wood Jones, M.B., D.Sc., F.Z.S., exhibited the skull of a Lioness which had lived for 17 years in the Gardens. This skull presented marked changes when compared with the crania of wild animals shown at the same time for comparison. The changes involved the whole contour of the skull and depended, for the most part, on loss of function. The parts concerned with actual mastication of food were but little changed; but the whole mechanism for seizing and holding living prey had undergone an atrophy in the menagerie animal. This atrophy was especially marked in the facial contour related to the canine teeth, and manifested itself by the production of a somewhat ursine appearance of this portion of the skull. At the same time the cranial capacity had undergone a marked diminution. The brain of this specimen was also exhibited.

The skull of a cub which was recently born in the Gardens was also shown; but no skull of a wild-born cub was available for comparison. The wild-born cub is a desideratum, the examination of which might possibly yield exceedingly valuable information.

Exhibits from the Caird Insect House.

(Text-figure 1.)

Miss Evelyn Cheesman made remarks on the feeding habits of the Long Water-Scorpion, *Ranatra linearis*, on the burrows made by the Mole-Cricket, *Gryllotalpa vulgaris*, and on the formation of the case by the Caddis-worm *Phryganea grandiosa*, based on observations made in the Caird Insect House, and exhibited examples of the living insects to the Meeting.

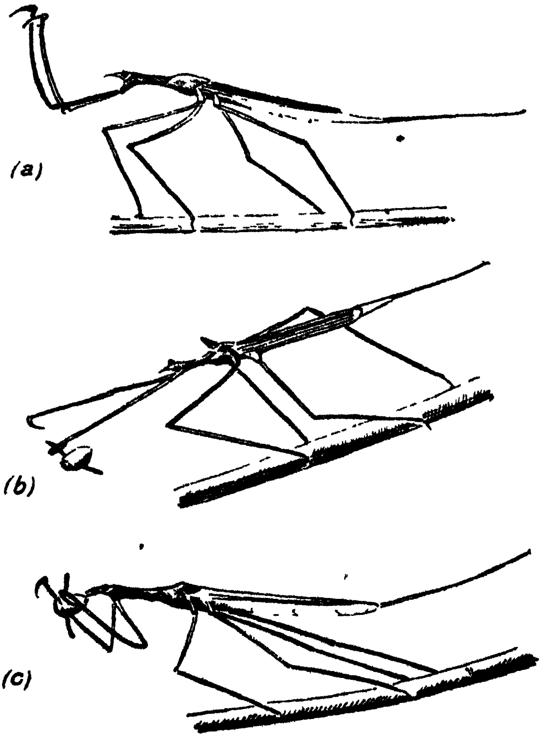
Ranatra linearis

has the first pair of legs modified to form instruments for seizing prey. These are kept scrupulously clean and ready for action. The morning toilet is an elaborate ceremony, each limb being minutely overhauled with special attention to the joints.

This insect is of an extremely lethargic nature, and will sit motionless for hours in the weed or on a plant-stem until something swims within reach, when the long fore-legs shoot out with a rapidity quite at variance with its other movements.

It occasionally hunts the bottom, probing the mud for prey, but makes no effort to pursue. The food consists principally of *Asellus* and *Gammarus*, small water-beetles, small dragonfly larvæ, etc., and even snails.

Text-figure 1.



Method of feeding of the Long Water-Scorpion, *Ranatra linearis*. × ⅔.
(*a*) Waiting for prey; (*b*) Seizing prey; (*c*) Piercing prey with the restrum.

Gryllotalpa vulgaris

is fortunately rare in England. The burrows being formed regardless of obstacles do much damage in cultivated ground, and make it a serious pest wherever it occurs in great numbers.

It is carnivorous, feeding mainly on worms. There is no previous record of its having been exhibited in the Caird Insect House, but this year three specimens were sent in from different sources for identification; in two instances the senders spoke of their being in numbers when found.

Phryganea grandiosa,

the largest of our Caddis-flies, when in the larval state forms its case from segments of the hollow stems of aquatic plants, then protects each joint by adding a frill composed of leaf-lobes from the Hornwort. To do this the larva climbs a plant, and forces itself into the top whorl, head downwards: then, when the leaf-lobes close round it, cuts them off and glues each singly on the case, the loose ends pointing backwards.

Mr. C. TATE REGAN, M.A., F.R.S., F.Z.S., described the present state of knowledge regarding the life-history of the Common Eel, illustrating his remarks with lantern-slides.

November 6th, 1917.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President,
in the Chair.

The Spalteholz Method of Preparation.

Mr. R. H. BURNE exhibited a Common Frog prepared by the method of Dr. Spalteholz, in which the highly elaborate saccus endolymphaticus of the internal ear was very clearly shown.

The method of preparation in question was introduced in 1906 by Dr. Spalteholz of Leipzig, and was subsequently brought by him to very considerable perfection. Its aim is to render the tissues of an organ or even of an entire small animal transparent.

The specimen is first thoroughly dehydrated and then fully permeated by a mixture of oils of refractive index as nearly as possible the same as that of the dehydrated tissue.

It will be noticed that the method is quite similar to that employed by the microscopist in clearing sections or small objects for examination by transmitted light. Its success when applied to gross objects depends on the degree of accuracy with which the refractive index of the clearing agent is adjusted to that of the tissues to be rendered transparent. With a clearing agent accurately compounded the results are often very brilliant and of considerable value for research or museum purposes. This is especially the case with complex organs or whole animals owing to the fact that different tissues have slightly different indices of refraction, so that in the finished preparation the whole object is not uniformly transparent, but the several parts appear in it as filmy shades of various opacity.

The method is particularly useful in the study of cavities, such as the blood-vessels, which when filled with an opaque injection can be seen in their true relations down to the minutest detail.

In the Frog exhibited the saccus endolymphaticus, owing to the fact that it is packed with calcium carbonate (otoconia), remains opaque, in the same way as an injection, though the rest of the body has been made transparent. Thus it stands out from its surroundings sharp and black when viewed by transmitted light, or brilliantly white if seen against a dark background by reflected light.

It is interesting to recall in connection with this comparatively new method of preparation that the older Anatomists were in the habit of using a method very similar both in principle and practise to obtain transparency for the study of the blood-vessels, centres of ossification and similar structures. Many of John Hunter's preparations were "dried and preserved in oil of turpentine," and even after more than 100 years show results, rougher no doubt, but still worthy to be compared with those obtained by Dr. Spalteholz.

Prof. F. Wood Jones, M.B., D.Sc., F.Z.S., exhibited a series of brains prepared in the Prosectorium, and called attention to the fact that specimens preserved by the spirit method differed not only in size but in surface details from those prepared by more perfect formalin methods, and commented on the necessity of revising much descriptive work on the anatomy of mammalian brains from the better material that was now available.

The Secretary, on behalf of Mr. D. Seth-Smith, F.Z.S., Curator of Birds, exhibited a set of lantern-slides prepared from photographs of mammals taken by Mr. Seth-Smith in the Society's Gardens.

November 20th, 1917.

E. G. B. Meade-Waldo, Esq., Vice-President,
in the Chair.

The Secretary read the following Report on the Additions made to the Society's Menagerie during the month of October, 1917:—

The registered additions to the Society's Menagerie during the month of October were 118 in number. Of these 36 were acquired by presentation, 77 were received on deposit, 3 received in exchange, and 2 were born in the Gardens.

The number of departures during the same period, by death and removals, was 125.

Amongst the additions special attention may be directed to:—

1 Humboldt's Woolly Monkey (*Lagothrix humboldti*), from Mañaos, presented by Miss Stella Wickham on October 1st.

3 Coypus (*Myocastor coypus*), from S. America, presented by Sir Edmund Loder, Bt., V.P.Z.S., on October 12th.

2 White-necked Cranes (*Pseudogeranus leucauchen*), bred in Northamptonshire, received in exchange on October 5th.

The Horns of a Castrated Bushbuck and the Antler-growth in Père David's Deer.

Mr. R. I. Pocock, F.R.S., F.Z.S., Curator of Mammals, exhibited:—

1. The head of a castrated Bushbuck (*Tragelaphus*) to show the effects of the operation on the horns. The horns differed from those of a normal Bushbuck in being slender, subcylindrical, untwisted, unkeeled, with a backward curvature like that of the horns of a Goral (*Nemorhedus*) or Serow (*Capricornis*). The Bushbuck had lived several years in the Zoological Gardens at Clifton, and the head was lent for exhibition by Mr. Edward Gerrard.

2 Three successive pairs of antlers of a fully adult Père David's Deer (*Elaphurus*), showing progressive increase in length. The first pair shed on Feb. 5th, 1916, measured 15 inches; the second pair shed on Oct. 22nd, 1916, 25 inches; and the third pair, unshed at the time of the stag's death, 40 inches.

Parturition in Marsupials and External Characters of New-born Young.

Prof. J. P. Hill, D.Sc., F.R.S., F.Z.S., gave an account of the new-born Marsupial and its mode of parturition. Lantern-slides of the recently born young belonging to species of the genera *Perameles*, *Dasyurus*, *Didelphys*, *Trichosurus*, and *Phascolarctos* were exhibited, and their chief external features described. Attention was directed to the fact that, whilst the new-born young in the different genera all exhibit similar adaptive modifications (small size, anterior half of body much in advance of posterior in degree of development, fore-limbs strongly developed and provided with recurved claws, sucking mouth, presence of thick epitrichial layer, covering eye and ear-pinnæ, &c.), there are recognisable structural and developmental differences between them—*e. g.*, the new-born *Dasyurus* is characterised by the presence of a curious swelling in the neck-region and by the absence of any indication of the digits of the foot. The early initiation of the lip-fusion, leading to the establishment of the sucking mouth, was demonstrated in a series of embryos of *Trichosurus*, and an interesting comparison was instituted between the recently hatched young of *Ornithorhynchus* and the new-born Marsupial.

The remarkable and unique mode of parturition which occurs in certain Marsupials was explained and illustrated by a series of micro-photographs. It was shown that in *Perameles*, *Dasyurus*, and *Trichosurus* the young reach the exterior, not through one or other of the lateral vaginal canals, but by way of a direct median passage, constituted in front by the epithelially lined median vagina and behind by a cleft-like "pseudo-vaginal passage," actually formed at the time of parturition as a tear in the connective tissue situated behind the median, and between the lateral vaginæ. The occurrence of the same mode of parturition was demonstrated for *Phascolarctos* (the fact being recorded here for the first time), and lantern-slides were shown indicating that the same mode of birth also holds good for the Gambá (*Didelphys aurita*). The bearing of these facts on the patent condition of the median vagina in certain Macropods was briefly discussed.

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PRINTED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.

No. 163.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 6th, 1917.

Prof. E. W. MACBRIDE, M.A., D.Sc., F.R.S., Vice-President, in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The SECRETARY read a Report on the Additions made to the Society's Menagerie during the months of November and December, 1916.

Mr. EDWARD GERRARD, on behalf of Mr. Crabb, exhibited a mounted specimen of a bird bred and reared in captivity under conditions in which it seemed certain that it was a hybrid between a male Thrush (*Turdus musicus*) and a female Blackbird (*Merula merula*).

Mr. L. A. BORRADAILE, M.A., F.Z.S., presented his memoir "On the Structure and Function of the Mouth-parts of the Palæmonid Prawns," and explained his conclusions by means of blackboard drawings, and also demonstrated the method of taking food, by means of living examples of prawns.

The Author regards the primitive crustacean limb as consisting of a flattened axis with a flabellum (exopodite), two or more epipodites, a series of eight endites, and an apical lobe, the flabellum standing opposite the third and fourth endites. He discussed the relation of the several jaws to this prototype.

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* This Abstract is published by the Society at its offices, Zoological Gardens, Regent's Park, N.W., on the Tuesday following the date of Meeting to which it refers. It will be issued, along with the 'Proceedings,' free of extra charge, to all Fellows who subscribe to the Publications; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

In the latter part of the paper he gave an account of some observations upon the use of the mouth-parts during feeding, in which he found the second maxillipeds, maxillules, and mandibles to play more important parts than the first maxillipeds and the maxillæ.

Prof. H. G. Plimmer, F.R.S., F.Z.S., Pathologist to the Society, read his Report on the Deaths which occurred in the Society's Gardens during 1916, and on the Blood-parasites found during the same period, and exhibited a series of lantern-slides showing the degenerative changes due to old age (sometimes premature) of animals that had lived under the conditions of captivity.

The next Meeting of the Society for Scientific Business will be held on Tuesday, February 20th, 1917, at 5.30 p.m., when the following communications will be made:—

C. J. C. Pool.

1. Notes from the Caird Insect House, with exhibition of specimens and lantern-slides.

2. The Coleoptera of the Family *Cissidæ* found in Britain, with Descriptions of two new Species. A new Species of the Coleopteran genus *Cryptorrhynchus* Illiger.

A. de C. Sowerby, F.Z.S.

On Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai.

G. A. Boulenger, F.R.S., F.Z.S.

On the Lizards of the genus *Philochortus* Matschie.

The following Papers have been received :—

F. E. Beddard, D.Sc., M.A., F.R.S.

On the Scolex in the Cestode Genus *Duthiersia*, and on the Species of that Genus.

E. Phelps Allis, Junr., F.Z.S.

The Prechordal Portion of the Chondrocranium of *Chimæra colliei*.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

Zoological Society of London,
Regent's Park, London, N.W.
February 13*th*, 1917.

No. 164.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 20th, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The Secretary read a Report on the Additions made to the Society's Menagerie during the month of January.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, exhibited the trachea from a male *Anseranas semipalmata*, showing its extraordinary convolution, which had been described by Latham as long ago as 1797. The exhibitor stated that neither in this species nor in *Phonygama keraudreni*, another species with a greatly developed convoluted trachea, did the birds produce any great volume of sound, such as might be expected from so elaborate an arrangement.

Mr. C. J. C. Pool, Assistant Curator of the Caird Insect House, exhibited a series of specimens and some lantern-slides of insects reared in the Insect House during 1916. Experiments showed that melanic variations of the Magpie Moth (*Abraxas grossulariata*) were not connected with melanic variations in the larva. In the case of Dragonflies, although the larvæ of several British species had been reared to maturity, it was found impossible under the conditions to feed the full-grown insects, which survived only a few days after emergence from the water. Similarly, it was found impossible to feed various species of Longicorn Coleoptera, although other beetles, differing as widely in diet as Carabidæ and Lamellicorns, fed readily on banana. Experimental feeding with beetles of the genus *Necrophorus*, showed that while these insects were refused by Meerkats (*Suricata*) they were eaten by a Mongoose and Capuchin Monkeys. Two examples of beetles, *Tetropium gabrieli* and *Donacia linearis*, exhibited interesting variations in the antennæ, the former having a supplementary short branch near the base of the right antenna and the latter ten instead of eleven joints to both antennæ.

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Mr. C. J. C. Pool also read a paper on the Coleoptera of the family Cissidæ, describing two new species, and a second paper on a new species of *Cryptorrhynchus*.

A paper by Mr. A. de C. Sowerby, F.Z.S., on Heude's types of Artiodactyle Ungulates in the Sikawei Museum, China, was read. In the case of the species of *Sus*, *Cervus*, *Capricornis*, and *Nemorhœdus* it was shown that Heude had disregarded variations due to age, season, and other causes, and that in each of these genera the number of species must be greatly reduced.

Mr. G. A. Boulenger, F.R.S., F.Z.S., presented a paper on the Lizards of the genus *Philochortus* Matschie.

The next Meeting of the Society for Scientific Business will be held on Tuesday, March 6th, 1917, at 5.30 P.M., when the following communications will be made:—

R. I. Pocock, F.R.S., F.Z.S.

Exhibition of the work of the Beavers in the Society's Gardens.

F. E. Beddard, M.A., D.Sc., F.R.S., F.Z.S.

On the Scolex in the Cestode Genus *Duthiersia*, and on the Species of that Genus.

Capt. S. R. Douglas, M.R.C.S., L.R.C.P., I.M.S. (retired), F.Z.S.

An Experimental Investigation of the Migration of Woodcock breeding in the west of Ireland.

The following Papers have been received:—

E. Phelps Allis, Junr., F.Z.S.

The Prechordal Portion of the Chondrocranium of *Chimæra colliei.*

D. M. S. Watson, F.Z.S.

A Sketch-classification of the Pre-Jurassic Tetrapod Vertebrates.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

Zoological Society of London,
Regent's Park, London, N.W.
February 27th, 1917.

No. 165.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 6th, 1917.

Dr. S. F. Harmer, M.A., F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

Dr. F. E. Beddard, M.A., D.Sc., F.R.S., F.Z.S., gave an account of his paper on the Scolex in the Cestode Genus *Duthiersia*, and on the Species of that Genus, illustrating his remarks with blackboard diagrams.

Captain S. R. Douglas, M.R.C.S., L.R.C.P., I.M.S. (retired), F.Z.S., gave an account of the results of an Experimental Investigation of the Migration of Woodcock breeding in the west of Ireland. The paper, which, among other interesting points, showed an increase in the number of Woodcock breeding in the west of Ireland, will be published in full in the 'Proceedings.'

Mr. R. I. Pocock, F.R.S., F.Z.S., gave an exhibition, illustrated by lantern slides, to show the work done by the Beavers in the Gardens in the old enclosure on the site of the new tunnel.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, March 20th, 1917, at **5.30** P.M., when the following communications will be made :—

E. PHELPS ALLIS, Junr., F.Z.S.

The Prechordal Portion of the Chondrocranium of *Chimæra colliei.*

D. M. S. WATSON, F.Z.S.

A Sketch-classification of the Pre-Jurassic Tetrapod Vertebrates.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W.
March 13th, 1917.

No. 166.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 20th, 1917.

Dr. A. Smith Woodward, F.R.S., Vice President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

Mr. R. I. Pocock, F.R.S., F.Z.S., Curator of Mammals, exhibited a young Lion Cub recently deposited in the Gardens, and also a Galago from German East Africa presented by Commander R. J. N. Watson.

Prof. J. P. Hill, D.Sc., F.R.S., presented a memoir by Mr. E. Phillips Allis, Junr., F.Z.S., entitled “The Prechordal Portion of the Chondrocranium of *Chimæra colliei*.”

Mr. D. M. S. Watson, M.Sc., F.Z.S., gave an account of a paper entitled “A Sketch-classification of the Pre-Jurassic Tetrapod Vertebrates.” The following is a summary of his remarks:—

The classification introduced in this paper is founded on a detailed consideration of all parts of the skeleton of such old amphibia and reptiles as are at all well known. In previous papers the author has analysed the features presented by many of these forms, distinguishing between those which are common to all early reptiles and those which are restricted to definite stocks; the latter being divided into those dependent on “adaptive radiation” and the more fundamental characters, especially those of the brain-case and ear, which are not to be correlated with any special mode of life. These non-adaptive characters, which appear in typical forms even in early members of a stock, serve for the ordinal and superordinal grouping, adaptive changes being used for groups of lower order and the gradual loss of primitive structures giving horizontal dividing lines.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, April 3rd, 1917, at **5.30** P.M., when the following communications will be made:—

ALFRED EZRA, F.Z.S.

Lantern exhibition illustrating Big-Game Shooting in India.

R. H. BURNE, M.A., F.Z.S.

Notes on some of the Viscera of an Okapi, *Okapia johnstoni*.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
March 27th, 1917.

No. 167.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

April 3rd, 1917.

Prof. E. W. MACBRIDE, M.A., D.Sc., F.R.S., Vice-President, in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

Mr. C. J. GAHAN exhibited a living example of the "Death-Watch" Beetle (*Anobium tesselatum*), and demonstrated its response to sharp taps, such as could be made with the point of a pencil on the table.

Mr. C. DAVIES SHERBORN, F.Z.S., exhibited an autograph of Captain Bligh of 'The Bounty.'

Mr. C. TATE REGAN, M.A., F.Z.S., exhibited a Piraya (*Serrasalmo piraya*) from the Amazon, and gave a short account of the habits of this ferocious fish.

Mr. ALFRED EZRA, F.Z.S., gave a lantern exhibition illustrating Big Game Shooting in Cooch Behar, Assam, and the Bhutan Duars, India.

Mr. R. H. BURNE, M.A., F.Z.S., presented his paper entitled "Notes on some of the Viscera of an Okapi (*Okapia johnstoni*

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Lankester)," in which he described the anatomy of the soft parts of various portions of this animal.

The next Meeting of the Society for Scientific Business will be held on Tuesday, April 17th, 1917, at **5.30** P.M., when the following communications will be made:—

C. DAVIES SHERBORN, F.Z.S.

The Original Fragments of Skin of the Gorilla sent by Du Chaillu to Owen, from the Gaboon, 1862.

E. HERON-ALLEN, F.L.S., F.Z.S.

Lantern Exhibition illustrating the Mussel-fishery and Foraminifera of Esnandes (La Rochelle), and the early work of Alcide d'Orbigny.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
April 10*th*, 1917.

No. 168.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

April 17th, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The Secretary read a Report on the Additions made to the Society's Menagerie during the month of March, 1917.

Mr. C. Davies Sherborn exhibited the piece of hairy skin of a Gorilla, which specimen was torn off the freshly killed beast, and posted to Richard Owen, by P. B. Du Chaillu, from the interior of the Gaboon. The envelope is postmarked "Etablissements du Gabon, 1 Sept 1864," and was the precursor of Du Chaillu's long letter of August, 1864, from the Fernand Vaz river on the coast, announcing that six skins were being shipped to London among other specimens. These were registered at the British Museum 1 Dec. 1864.

Mr. D. Seth-Smith, Curator of Birds, exhibited a female Japanese Pheasant (*Phasianus versicolor*) which had assumed the very nearly complete plumage of the male. The ovaries were found on dissection to be very atrophied.

A male specimen of the Carolina Duck (*Æx sponsa*) was also shown in which the colour of the soft parts were similar to those of the female. When living, this bird was thought to be a female in male plumage, but on dissection proved to be a male with atrophied testes.

Mr. Seth-Smith also showed some specimens of the trachea of various species of Ducks.

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* This Abstract is published by the Society at its offices, Zoological Gardens, Regent's Park, N.W., on the Tuesday following the date of Meeting to which it refers. It will be issued, along with the 'Proceedings,' free of extra charge, to all Fellows who subscribe to the Publications; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

Mr. E. Heron-Allen, F.L.S., P.R.M.S., F.Z.S., described the Mussel-fishery and Foraminifera of Esnandes (La Rochelle), and the early work of Alcide d'Orbigny.

A series of slides was exhibited illustrative of the early studies of Alcide d'Orbigny at Esnandes, (near La Rochelle), and the Mussel-fisheries established there since the year 1035. The experiments of Prof. W. A. Herdman on the West Coast of England were referred to, and those of Prof. A. Meek at Holy Island on the East Coast. A further series was shown illustrating some of the notable d'Orbignyan species found in the neighbourhood, not recorded from there by d'Orbigny in 1826, but recorded from other localities at that date, and from distant seas between 1839 and 1846. A third series of slides illustrated well-known species from the locality which had been recorded and described by earlier authors, but were not apparently identified by d'Orbigny from the neighbourhood of La Rochelle.

The next Meeting of the Society for Scientific Business will be held on Tuesday, May 1st, 1917, at **5.30** P.M., when the following communications will be made:

Prof. H. Maxwell Lefroy, M.A., F.Z.S.

Lantern Exhibition of the Wild Silk Moths of India.

Prof. J. P. Hill, F.R.S., F.Z.S.

Exhibition of a gyandromorphic Earwig (*Forficula auricularia*).

Dr. A. Smith Woodward, F.R.S., V.P.Z.S.

Exhibition of drawings of the molar tooth of *Eoanthropus*.

The Publication Committee desire to call the attention of those who propose to offer Papers to the Society, to the great increase in the cost of paper and printing. This will render it necessary for the present that papers should be condensed, and be limited so far as possible to the description of new results.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
April 24th, 1917.

No. 169.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

May 1st, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The Secretary, Dr. P. Chalmers Mitchell, F.R.S., announced with the deepest regret that Mr. Henry Peavot, the Society's Librarian and Clerk of Publications, had been killed in action. Mr. Peavot had entered the service of the Society in 1896, and, after passing through various departments, was appointed Assistant Librarian and Clerk of Publications in 1908, and was promoted to the post of Librarian and Clerk of Publications in 1912. In every way he had gained the esteem and regard of the Scientific Fellows of the Society, and was one of the most valuable and competent members of the Society's staff.

The Secretary exhibited a coloured sketch of an abnormal Cape Lourie (*Turacus corythaix* Wagl.), kindly sent to him by Mr. E. C. Chubb, F.Z.S., the Curator of the Durban Museum, Natal. The specimen, which was the property of the Durban Museum, was normally coloured on the head and neck, but the rest of the plumage was pale grey or dirty white, with the exception of a portion of the wings, which retained the normal red colour. The example could not be exactly described as an albino, inasmuch as the red colour was known to be due to a pigment, the "Turacin" originally described by Professor Church, and the green colour of the head and neck, unlike that in most species of birds with green feathers, was due also to a green pigment.

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Professor J. P. HILL, F.R.S., F.Z.S., exhibited an example of an Earwig (*Forficula auricularia*) showing a gynandromorphic condition, and explained its structure by means of lantern-slides.

Dr. A. SMITH WOODWARD, F.R.S., Vice-President, exhibited enlarged models, made by Mr. Frank O. Barlow, of the first lower molar tooth of a large Chimpanzee, Melanesian Man, and Piltdown Man (*Eoanthropus dawsoni*). He maintained that the latter tooth was of the megadont human type.

Mr. D. M. S. WATSON, F.Z.S., exhibited and explained by diagrams, models of the teeth of fossil horses.

Professor H. MAXWELL LEFROY, M.A., F.Z.S., described the Silkworms and Silk industry of India, illustrating his account with lantern-slides and specimens of the Silk Moths, Cocoons, and Silk.

The next Meeting of the Society for Scientific Business will be held on Tuesday, May 15th, 1917, at 5.30 P.M., when the following communications will be made:—

THE SECRETARY, Dr. CHALMERS MITCHELL, F.R.S.

Demonstration of the Behaviour of Living Birds and Mammals in the presence of Snakes.

Mr. D. SETH SMITH, F.Z.S.

Lantern Exhibition of Birds now or recently living in the Society's Collection.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W.
May 8th, 1917.

No. 170.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.[*]

May 15th, 1917.

Dr. S. F. Harmer, M.A., F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The Secretary read a Report on the Additions made to the Society's Menagerie during the month of April, 1917.

Dr. P. Chalmers Mitchell, M.A., D.Sc., F.R.S., Secretary to the Society, showed the behaviour of a large series of Birds and Mammals in the presence of living Serpents, and demonstrated that, except in the case of the higher Monkeys and a few kinds of Birds, there was no trace of instinctive dread of Serpents.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, gave a lantern exhibition of Birds now or recently living in the Society's Gardens.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, June 5th, 1917, at **5.30** P.M., when the following communications will be made:—

R. I. POCOCK, F.R.S., F.Z.S.

Exhibition on behalf of Messrs. Rowland Ward of two Zebra-skins showing abnormal pattern.

D. SETH-SMITH, F.Z.S.

Account of the Poultry Exhibition. After this the Meeting will visit the Exhibition if the weather permit.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W.
May 22nd, 1917.

No. 171.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

June 5th, 1917.

Dr. S. F. Harmer, M.A., F.R.S., Vice-President, in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

Mr. R. I. Pocock, F.R.S., Curator of Mammals, exhibited on behalf of Messrs. Rowland Ward Ltd. the skins of two Zebras, shot by Mr. David Mackenzie at Gil-Gil in British East Africa, which showed remarkable evanescence of pattern affecting the body, neck, and head and to a less extent the legs. The obliteration of pattern was carried to a much greater extent than in the skin described by Prof. Ridgeway as representing a new variety named *Equus quagga goldfinchi*.

The two specimens were secured from a herd of normally coloured Zebras of the East African race *Equus quagga granti*.

Mr. R. E. Holding exhibited and made remarks on a Cirriped (*Coronula diadema*) which occurs in considerable numbers on the Humpbacked Whale (*Megaptera nodosa* Bonn.).

Mr. Holding also exhibited two curiously malformed eggs in which the inner membrane only remained, the shell and yolk being absent.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, gave an account of the Poultry Exhibition which the Society is now holding for the second season with a view to the encouragement of poultry-keeping for egg-production. The method of keeping hens on the intensive system was explained, as well as the lines to be followed in the breeding and selection of heavy-laying strains. Mr. Seth-Smith called attention to the value of certain strains of ducks, especially those known as "white runners," for egg-production.

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This Meeting closes the Session 1916 1917. The next Meeting of the Society for Scientific Business will be held on Tuesday, October 23rd, 1917, at half-past FIVE o'clock P.M.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W.
June 12*th*, 1917.

No. 172.

ABSTRACT OF THE PROCEEDINGS
OF THE
ZOOLOGICAL SOCIETY OF LONDON.*

October 23rd, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The Secretary read a Report on the Additions made to the Society's Menagerie during the months of May, June, July, August, and September, 1917.

Prof. F. Wood Jones, M.B., D.Sc., exhibited the skull of a lioness which had lived for seventeen years in the Gardens and showed definite changes induced by captivity. The brain of the same animal was shown. For contrast, the skull of a wild African lion and of some other forms were lent by the Royal College of Surgeons. The fœtal skull of a cub born in the Gardens was also exhibited.

Miss Evelyn Cheesman made some remarks on the feeding habits of the Long Water-Scorpion, *Ranatra*; on the burrows made by the Mole-Cricket, *Gryllotalpa*; and on the formation of the case by the Caddis-worm *Phryganea grandiosa*, based on observations made in the Caird Insect House, and exhibited examples of the living insects to the Meeting.

Mr. H. D. Badcock gave an account of his communication entitled "Ant-like Spiders from Malaya, collected by the Annandale-Robinson Expedition, 1901-2."

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Mr. C. TATE REGAN, M.A., F.R.S., on behalf of Miss RUTH C. BAMBER, M.Sc., communicated a paper on a hermaphrodite Dogfish.

Mr. TATE REGAN also described the present state of knowledge regarding the life-history of the Common Eel, illustrating his account with lantern-slides.

The next Meeting of the Society for Scientific Business will be held on Tuesday, November 6th, 1917, at **5.30** P.M., when the following communications will be made:

D. SETH-SMITH, F.Z.S.

Lantern Exhibition of photographs of Mammals and Reptiles from the Society's Gardens.

Lieut. F. F. LAIDLAW, M.A., F.Z.S.

Some Additions to the known Dragonfly Fauna of Borneo, with an account of new species of the genus *Caliccia*.

G. A. BOULENGER, F.R.S., F.Z.S.

On the use of the Names *Plesiosauria* and *Sauropterygia*.

J. C. MOTTRAM, M.B.

Some Observations upon Concealment by the apparent Disruption of Surface in a plane at right angles to the Surface.

The following Papers have been received:—

J. J. JOICEY, F.Z.S., and GEORGE TALBOT.

a. New South American Rhopalocera.

b. New South American Arctiidæ.

c. New Butterflies from Africa and the East.

d. Gynandromorph of *Papilio lycophron* Hbn.

e. Three Aberrations of Lepidoptera.

B. L. BHATIA and BAINI PARSHAD.

Notes on the Skull of *Rana tigrina*.

SERGIUS ALPHÉRAKY.

Deformity of *os penis* in a *Phoca caspica* Nilsson.

Lt.-Col. J. M. FAWCETT.

Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911-13.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
October 30th, 1917.

No. 173.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

November 6th, 1917.

Dr. A. Smith Woodward, F.R.S., Vice-President,
in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

Mr. R. H. Burne, M.A., F.Z.S., exhibited preparations of the Frog made by the Spalteholz method, and explained the difficulties and advantages of the process.

Prof. F. Wood Jones, M.B., D.Sc., F.Z.S., exhibited a series of brains prepared in the Prosectorium, and called attention to the fact that specimens preserved by the spirit method differed not only in size but in surface details from those prepared by more perfect formalin methods, and commented on the necessity of revising much descriptive work on the anatomy of mammalian brains from the better material that was now available.

On behalf of Lieut. F. F. Laidlaw, M.A., F.Z.S., R.A.M.C., absent on active service, a paper was presented entitled "Some Additions to the known Dragonfly Fauna of Borneo, with an Account of new Species of the Genus *Cœliccia*."

Dr. G. A. Boulenger, F.R.S., F.Z.S., communicated a note on the use of the names *Plesiosauria* and *Sauropterygia*.

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Dr. J. C. **Mottram**, M.B., gave an account of his communication entitled "Some Observations upon Concealment by the apparent Disruption of Surface in a Plane at Right Angles to the Surface," and illustrated his remarks with lantern-slides.

The Secretary, on behalf of Mr. D. Seth-Smith, F.Z.S., Curator of Birds, exhibited a set of lantern-slides prepared from photographs of mammals taken by Mr. Seth-Smith in the Society's Gardens.

The next Meeting of the Society for Scientific Business will be held on Tuesday, November 20th, 1917, at **5.30** P.M., when the following communications will be made:—

EXHIBITIONS AND NOTICES:

S. A. Neave, F.Z.S.

Exhibition of Lantern-slides illustrating the scenery of different regions of Africa with remarks about the characteristic fauna.

Professor J. P. Hill, D.Sc., F.R.S., F.Z.S.

The new-born Marsupial and its mode of birth, illustrated by lantern-slides.

Professor E. W. MacBride, M.A., D.Sc., F.R.S., F.Z.S.

The development of *Echinocardium cordatum*.

J. J. Joicey, F.Z.S., and George Talbot.

a. New South American Rhopalocera.

b. New South American Arctiidæ.

c. New Butterflies from Africa and the East.

d. Gynandromorph of *Papilio lycophron* Hbn.

e. Three Aberrations of Lepidoptera.

SERGIUS ALPHERAKY.

Deformity of *os penis* in a *Phoca caspica* Nilsson.

Lt.-Col. J. M. FAWCETT.

Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13.

The following Paper has been received:—

B. L. BHATIA, M.Sc., and BAINI PARSHAD, M.Sc.

Notes on the Skull of *Rana tigrina*.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
November 13*th*, 1917.

No. 174.

ABSTRACT OF THE PROCEEDINGS
OF THE
ZOOLOGICAL SOCIETY OF LONDON.

November 20th, 1917.

E. G. B. MEADE-WALDO, Esq., Vice-President, in the Chair.

The Minutes of the last Scientific Meeting were confirmed.

The SECRETARY read a Report on the Additions made to the Society's Menagerie during the month of October, 1917.

Mr. R. I. POCOCK, F.R.S., F.Z.S., Curator of Mammals, exhibited:—

1. The head of a castrated Bushbuck (*Tragelaphus*) to show the effects of the operation on the horns. The horns differed from those of a normal Bushbuck in being slender, subcylindrical, untwisted, unkeeled, with a backward curvature like that of the horns of a Goral (*Næmorhedus*) or Serow (*Capricornis*). The Bushbuck had lived several years in the Zoological Gardens at Clifton, and the head was lent for exhibition by Mr. Edward Gerrard.

2. Three successive pairs of antlers of a fully adult Père David's Deer (*Elaphurus*), showing progressive increase in length. The first pair shed on Feb. 5th, 1916, measured 15 inches; the second pair shed on Oct. 22nd, 1916, 25 inches; and the third pair, unshed at the time of the stag's death 40 inches.

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Professor J. P. Hill, D.Sc., F.R.S., F.Z.S., described new-born Marsupials of many different genera and species, and explained the modes of parturition, illustrating his account with lantern-slides.

The following Papers were presented to the Meeting:—

Messrs. J. J. Joicey, F.Z.S., and George Talbot: (*a*) New South American Rhopalocera, (*b*) New South American Arctiidæ, (*c*) New Butterflies from Africa and the East, (*d*) Gynandromorph of *Papilio lycophron* Hbn., and (*e*) Three Aberrations of Lepidoptera.

Mr. Sergius Alphéraky (communicated by Mr. Oldfield Thomas, F.R.S., F.Z.S.),: Deformity of *os penis* in a *Phoca caspica* Nilsson.

Lt.-Col. J. M. Fawcett (communicated by The Secretary): Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13.

Professor F. Wood Jones, M.B., D.Sc., F.Z.S.: The Structure of the Orbito-temporal Region of the Skull of *Lemur*.

Mr. S. A. Neave, F.Z.S., gave an Exhibition of Lantern-slides illustrating the scenery of different regions of Africa with remarks about the characteristic Fauna.

The next Meeting of the Society for Scientific Business will be held on Tuesday, February 5th, 1918, at **5.30** P.M.
The agenda will be announced early in January.

The following Paper has been received:—

B. L. Bhatia, M Sc., and Baini Parshad, M.Sc.

Notes on the Skull of *Rana tigrina*.

Communications intended for the Scientific Meetings should be addressed to

P. CHALMERS MITCHELL,
Secretary.

ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, N.W. 8.
November 27th, 1917.

I. A. R. I. 75.

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